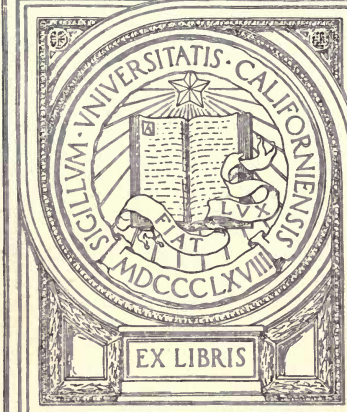
British museum (Natural history)
Department of Botany
Guide to the British mycetozoa



GUIDE

TO THE

BRITISH MYCETOZOA

EXHIBITED IN THE

DEPARTMENT OF BOTANY

BRITISH MUSEUM (NATURAL HISTORY)

FOURTH EDITION

LONDON
PRINTED BY ORDER OF THE TRUSTEES OF
THE BRITISH MUSEUM
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PRICE ONE SHILLING

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PREFACE TO FIRST EDITION

THE collection of British Mycetozoa, and the series of coloured drawings explaining their structure, exhibited in the Botanical Gallery, have been presented by Mr. Arthur Lister, the author of this Guide. All known British Mycetozoa are described briefly, and it is hoped that this account will serve as an introduction to the systematic study of the group.

In preparing his *Monograph of the Mycetozoa*, based on the collection in the British Museum, Mr. Lister generously enriched the National Herbarium by the gift of numerous specimens which had the special value of having been named after comparison with type specimens in the herbaria of the Royal Gardens, Kew; the Botanic Gardens, Edinburgh, Strassburg, Paris, Christiania, Leyden; the collections of Messrs. Phillips and Massee, in this country, and with specimens furnished by Dr. Rex, Prof. Farlow of Harvard University, Prof. Macbride of the State University of Iowa, and Mr. Morgan of Ohio.

For the purpose of ready microscopic examination Mr. Lister also prepared and presented to the Trustees eight hundred and thirty-two mounted slides, illustrating the British Museum collection of Mycetozoa, and they are preserved in a cabinet in the Cryptogamic Herbarium for consultation by students.

The present Guide is based on the study of this valuable material, and in its preparation Mr. Lister has had the advantage of the diligent assistance of his daughter, Miss Gulielma Lister, who has also made the coloured drawings exhibited in the case.

GEORGE MURRAY.

1895.

NOTE TO SECOND EDITION

THE present edition has been revised throughout by the author, and numerous additions have been made, thus bringing the work up to the standard of our present knowledge of the British Mycetozoa.

April, 1905.

NOTE TO THIRD EDITION

OWING to Mr. Arthur Lister's regretted death last July, the slight revision necessary for the present edition has been undertaken by Miss Gulielma Lister, who was intimately associated with her father in his work on the Mycetozoa.

Species and varieties not mentioned in the British Museum Catalogue are followed by references to the place of publication.

A. B. RENDLE.

DEPARTMENT OF BOTANY.
January, 1909.

NOTE TO FOURTH EDITION

THE present edition has been carefully revised by Miss Gulielma Lister. The publication of a new edition of the *Monograph of the Mycetozoa*, in 1911, in which the nomenclature was brought into conformity with the International Rules, has necessitated some alterations in the names of genera and species in the present edition of the Guide.

An important advance in our knowledge of the life-history of the Mycetozoa, to which reference is made in the Introduction, is the discovery that the swarm-cells fuse in pairs and that the resulting zygote forms the plasmodium.

Notes have been added to the Introduction on methods of cultivation of the plasmodium and the swarm-cells ; and on the collecting, preserving and mounting of specimens.

The number of species recorded as British has been increased since the date of the last edition, from 146 to 180 ; this increase indicates the value of local work carried out by individual observers.

An innovation in the text is the noting under each species of the time of year when the sporangia may usually be found in Britain ; and also the derivation and meaning of the generic and specific names.

A. B. RENDLE

DEPARTMENT OF BOTANY.
May, 19 9.

BRITISH MYCETOZOA

INTRODUCTION

THE Mycetozoa are a group of organisms which may be placed on the border-land between the Animal and Vegetable Kingdoms. They are characterised by the constant sequence of three main stages in their life-history, viz. :—

1. The firm-walled spore gives birth to a *swarm-cell*, which soon acquires a flagellum.
2. The swarm-cells after division coalesce in pairs and grow to form wandering *plasmodia*.
3. The plasmodium ultimately concentrates to form either *sporangia*, enclosing numerous spores (Endosporeæ), or *sporophores*, bearing spores on their outer surface (Exosporeæ).

Many species are quite common, and are found on old decaying stumps and fallen branches in moist woods and shaded gardens; others inhabit heaps of old straw and dead leaves which have lain undisturbed and become soaked with rain. The stage in which they are most conspicuous is that of the sporangia, when they appear as minute objects, some roundish, about the size of small mustard seeds, others rising in clusters of brown columns on black hair-like stalks, while many take other characteristic forms. The different species display great variety and beauty in the colours they assume, ranging from pure white, golden yellow, bright crimson, and iridescent violet to dark purple and black.

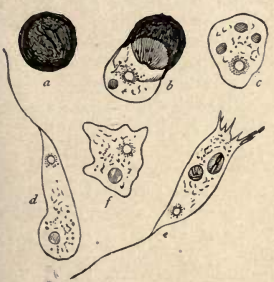

Fig. 1.—DIDYMIUM DIFFORME Duby.

a. Spore.
b. Swarm-cell escaping from the spore-case.
c. Newly hatched swarm-cell containing a nucleus and three vacuoles.
d. Flagellula.
e. Flagellula, with two vacuoles containing bacteria, and produced at the posterior end into pseudopodia, to one of which a bacterium is attached.
f. Amœbulæ.

Magnified 720 times.

The various phases in the life-history of the group may be described as follows :—

Swarm-cells. After a period of immersion in water the swarm-cells emerge from the spores as creeping *amœbulæ* (Fig. 1); each soon acquires a flagellum and moves along with the flagellum extended in advance, or swims in the surrounding water with a dancing motion occasioned by the lashing movement of the flagellum. The swarm-cell in this stage is called a *flagellula*. It possesses a single *nucleus* placed immediately behind and connected with the flagellum, and a *contractile vacuole*, which has an excretory function. To a large extent the swarm-cells feed on bacteria, which are caught by slender processes, *pseudopodia*, projected from the

posterior end of the body. The bacteria are conveyed into the body-substance, where they are digested in vacuoles which form round them; there may be one or more digestive vacuoles, each containing several bacteria, at one time. The swarm-cells rapidly increase in number by bipartition. When this takes place the flagellum is first withdrawn, and the swarm-cell assumes a globular form; it then elongates, a constriction occurs at right angles to the long axis, and the cell divides into two; each daughter-cell acquires a flagellum and assumes the active state. Meanwhile the nucleus has also divided, by the complex process known as karyokinesis, and each half has passed into one of the daughter-cells.

Microcysts. In all cultivations of germinating spores a number of the swarm-cells, after a short time of activity, become encysted in a globular form as *microcysts*. In this state they may remain dry

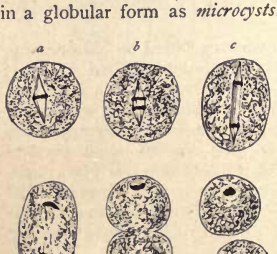

Fig. 2.—AMAUROCHÆTE FULIGINOSA Macbr.

a to *f*. Successive stages in bipartition of swarm-cell, accompanied by the division of the nucleus by karyokinesis. Magnified 1200 times.

Drawn from stained preparations in Canada balsam.

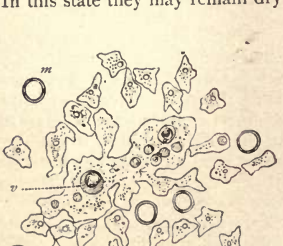

Fig. 3.—DIDYMIUM DIFFORME Duby.

Young plasmodium and amœbulæ, some of which have turned into microcysts (*m*); one microcyst is being digested in a vacuole (*v*). An empty spore-shell is shown at *s*. Magnified 470 times.

for several days, but on water being added the cyst-wall is ruptured and the contents creep out and assume again the motile condition. Frequently the entire group of swarm-cells will change to microcysts, and reawaken in the course of two or three days while still immersed in water. A few days after the germination of the spores, the process of bipartition, by which the number of the swarm-cells has greatly increased, ceases. The majority withdraw the flagellum, and once more become amœbulæ.

Plasmodium. These amœbulæ now collect in groups and proceed to unite in pairs; the nuclei of each pair also unite. It has been observed that in this union the amœbulæ do not fuse indiscriminately with one another, but exercise a selective faculty, indicating that, though outwardly similar, they possess a primitive

kind of sexual distinction. The united pairs form the young *plasmodia*, which grow partly by feeding on bacteria and decaying vegetable matter, partly by devouring unpaired amœbulæ, and partly by uniting with other plasmodia. With the growth of the plasmodium the nuclei increase in numbers, dividing by karyokinesis, and probably also by direct division. In search of food, the plasmodium spreads in veins of naked protoplasm on decaying leaves, or within the substance of dead wood. Through these veins the more fluid matter in the interior streams constantly in a rhythmic flow. The current continues in one direction for a certain period, usually a minute and a half, when it stops, and after a moment's pause reverses its course, flowing the opposite way for about the same length of time, but rather longer in the direction in which the mass is advancing. By means of this rhythmic circulation a close communication is main-

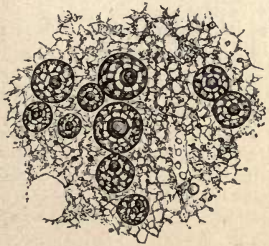

Fig. 4.—BADHAMIA UTRICULARIS Berk.

Group of nuclei from actively feeding plasmodium, showing the irregular size of the nuclei and large nucleoli.
Stained in picro-carmine and mounted in Canada balsam. Magnified 1200 times.

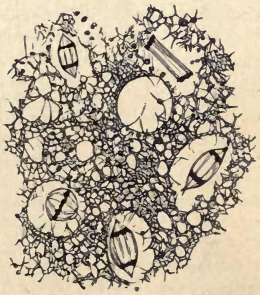

Fig. 5.—BADHAMIA UTRICULARIS Berk.

Division of nuclei by karyokinesis in the streaming plasmodium. Magnified 1200 times.
From a preparation stained in safranin, and mounted in Canada balsam.

tained between all parts of the plasmodium, however widely its veins may have travelled. The colour of the plasmodium varies in different species; it may be hyaline, white, yellow, green, rosy or purple. The yellow plasmodium of *Badhamia utricularis* feeds on leathery fungi; if cultivated on *Stereum hirsutum* on a plate and covered with a glass shade, it extends itself over the fungus with a turgid advancing border until it has devoured the more delicate hyphæ. Having exhausted the nutriment, it will spread over the plate and the interior of the glass shade. If it is in sufficient quantity, it will in the course of a few days cover the glass with a network of veins over an area of perhaps forty or fifty square inches. A piece of fresh *Stereum*, soaked in water, may now be inserted beneath the shade, allowing it to come in contact with one of the smallest veins. In a few hours the whole of the plasmodium will

have withdrawn from the sides of the shade, and concentrated itself on the fresh food in a dense yellow mass. The length of time during which the plasmodium will continue to feed and increase in bulk before changing into sporangia differs according to the species, and also to the conditions of its surroundings. *Physarum psittacinum*, which inhabits the rotten stumps of old trees, appears to pass twelve months in the plasmodium stage; on the other hand, *Didymium difforme* will go through the several stages from germination of the spores to the formation of the sporangia in a few days. The latter species is very common, and may easily be cultivated. The spores can be sown in water on a thin cover-slip supported over a glass slide by a ring of wet blotting-paper, and the required nutriment supplied by two or three slices of the mucilaginous coat of a garden-cress seed, in which bacteria rapidly develop: in this moist chamber the whole process of the division of the swarm cells, their coalescence to form plasmodia, and the construction of the sporangia, may be watched under the microscope.

Sclerotium. The plasmodium, if allowed to dry, or when subjected to great cold, passes into the *sclerotium* or resting stage. The sclerotium of *Badhamia utricularis* is dull orange-red in colour, of horny consistence, and made up of a multitude of thin-walled cysts closely packed together; each cyst is filled with granular protoplasm, among which ten to twenty nuclei are interspersed. On being wetted the sclerotium will revive in the course of a few hours and resume the streaming movement. Preserved in a dry state, it will retain its vitality for three or four years, but it is longer in reviving according to the length of time it has remained in the resting condition.

Sporangium and Spore-formation. The formation of the sporangium may be illustrated by the growth of *Comatricha nigra*, a common species which is often found on the under side of fir planks that have been left to rot on the ground. When the fruiting period arrives, the watery-white plasmodium issues from the wood at a point favourable to the development of the sporangia, and spreads over an area measuring perhaps half an inch across. After a time the plasmodium is seen to concentrate in thirty or forty centres, and in an hour or two each centre has risen into a pear-shaped body with a narrow base, a short dark stalk being just apparent through the translucent substance. In six hours the black hair-like stalk has grown to its full length, and bears at its summit the young sporangium, which consists of a white globule of viscid plasma with a diameter about one-fifth of the length of the stalk. A pink flush now begins to pervade the sporangium, caused by the formation within it of the dark flexuose threads of the *capillitium* (referred to afterwards). A little later, the nuclei, which until now have been in the resting stage, begin to divide by a form of karyokinesis known as a reduction division (Fig. 6); as the process advances the plasma becomes separated in masses of two spores' capacity (Fig. 7); an hour later and the final division into spores

takes place. As the dark spore-walls are produced the colour of the sporangia rapidly changes, and in about twenty hours after the first concentration of the plasmodium they have matured and present the appearance of a cluster of minute black pins, with round or oblong heads, standing in regular order on the wood.

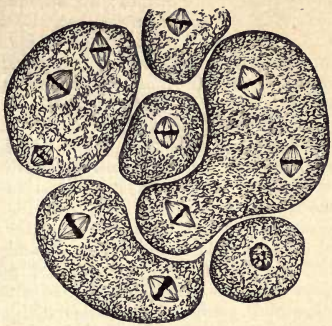

Fig. 6.—COMATRICHA NIGRA Schrœt.

From a stained preparation of a young sporangium, showing the plasmodium separated into rounded masses about groups of nuclei, which are dividing by karyokinesis; the nuclear division has reached the "spindle stage"; the spindles are seen in profile in all cases but one, in which the equatorial plate is seen from one of the poles of the spindle. Magnified 1200 times.

The sporangia of different species take various forms such as are represented by the woodcuts illustrating the different genera. They may be either symmetrical or irregular in shape, and with or without a stalk. When sessile and of irregular form, as shown in Fig. 13, they have received the name of *plasmodiocarps*. When many sporangia are combined, and their separating walls are imperfectly developed, the cluster is called an *æthalium*.

As the sporangia are formed, a membranous or calcareous residuum or *hypothallus* is often secreted by the plasmodium, and persists as a base on which the sporangia are seated.

Fig. 7.—COMATRICHA NIGRA Schrœt.

From a stained preparation of a young sporangium, showing the plasmodium separated into masses of two spores' capacity round the nuclei, which have almost divided by karyokinesis. Magnified 1200 times.

Capillitium. In most genera a *capillitium*, consisting of simple or branching threads or tubes, is formed within the sporangium. It differs widely in structure in different genera, and is beautifully adapted to assist in the dispersion of the spores on their reaching maturity. In many species it extends from the base of the sporangium, or from an extension of the stalk within the sporangium (the *columella*), to the enclosing wall. In *Trichia* the capillitium-tubes lie free among the spores, and, being provided with spirally

thickened bands which are strongly hygroscopic, twist and writhe with every change of moisture; by this action they separate the spores, so that they are easily carried away by the wind; such free tubes are called *elaters*. In *Stemonitis* the capillitium springs from the columella, and extends to the surface of the sporangium, where it forms an enclosing net; the evanescent membrane covering the meshes shrivels up on ripening, so that the spores lie in an open-work basket, and are blown by the wind through the openings. In *Arcyria* the capillitium consists of a dense tangle of branching threads, which, as the sporangium dries and the delicate sporangium-wall disappears, expands to many times the original volume, and in so doing scatters the spores on all sides.

Calcium carbonate is usually abundant in the form of granules in the plasmodium and young sporangia of the species comprised in the subcohort *Calcarineæ*. In most genera of the order *Physaraceæ* these granules are withdrawn before the spores are formed, and are deposited partly in the sporangium-wall, and partly in vesicular expansions of the capillitium. These expansions take various shapes; they are globose, fusiform, or branched, and are sometimes fused together in the centre of the sporangium, forming a *pseudo-columella*. In the descriptions of the species they are termed *lime-knots*. In the *Didymiaceæ* the granules in the young sporangia are dissolved at a certain stage, and the salt forms again in crystals on the outside of the wall. The genus *Cribraria* is one of several in which no capillitium is present; the upper part of the sporangium-wall consists of an open net through the meshes of which the spores escape.

Exosporeæ. The subclass *Exosporeæ* is represented by the single genus *Ceratiomyxa*, and is characterised by having the numerous white spores borne on the outside of fragile branching sporophores. The colourless plasmodium inhabits decayed wood. When coming to the surface to fructify, it emerges in the form of transparent cushions of jelly, whose substance is traversed by a dense network of protoplasmic veins within which the rhythmic circulation characteristic of Mycetozoa may be observed. From the cushions, finger-like branches grow out, the protoplasmic veins within still forming a sponge-like network; but as the branches attain their full size, the network concentrates on the surface and forms there an enveloping layer. It is at this stage that the nuclei undergo a reduction division. The network of protoplasm then divides into a mosaic of cells clothing the surface of the gelatinous sporophores; finally each cell pushes outward and grows into a long-stalked spore. In the mosaic stage, each cell contains a nucleus which passes into the young spore. Here it divides twice by karyokinesis; thus the mature spore contains four nuclei. On placing the ripe ellipsoid spore in water, the membranous wall at once slips off from the swelling of the contents; the four nuclei divide by karyokinesis, and the whole cell separates successively into two, four and eight parts; finally each of

the eight uni-nucleate divisions acquires a flagellum and swims off as a swarm-cell; the further history of the swarm-cells has not been traced, but it is probably the same as in the *Endosporeæ*.

The development of *Ceratiomyxa* may be briefly compared with one of the wood-inhabiting species of the *Endosporeæ*. In both the plasmodium emerges in the form of cushions of jelly to fructify in the open air. In both the nuclei undergo a reduction division before spore-formation. The sporophore in the mosaic stage might possibly be regarded as a sporangium with an undeveloped or evanescent wall, and with a large gelatinous columella, over whose surface the spore-cells form only a single layer; but the outgrowth of the spore-cells to form stalked spores in *Ceratiomyxa* is quite a unique arrangement; moreover, in these spores a process of what may be regarded as precocious development occurs by which each mature spore contains four nuclei, and these, when germination takes place, at once divide again to take charge of the eight swarm-cells into which the spore-contents separate. In the *Endosporeæ* the increase of eight swarm-cells from one spore is arrived at leisurely and after repeated intervals of feeding. Thus *Ceratiomyxa* holds a curiously solitary position among the Mycetozoa.

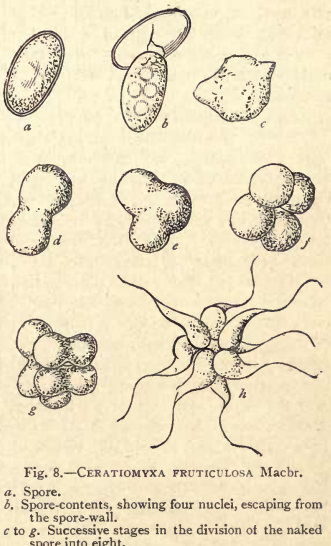

Fig. 8.—CERATIOMYXA FRUTICULOSA Macbr.

a. Spore.
b. Spore-contents, showing four nuclei, escaping from the spore-wall.
c to *g*. Successive stages in the division of the naked spore into eight.
h. Cluster of eight swarm-cells.
Magnified 1200 times.

Distribution and Habitats. The Mycetozoa are remarkably cosmopolitan, being found all over the world wherever there is sufficient vegetation and moisture to afford them support; yet some species are especially abundant in tropical regions, others are found chiefly in temperate or in alpine lands.

The situations which they frequent are many and varied; and although some species may be found in several different habitats, each habitat is usually characterised by a distinct association of Mycetozoa. Such haunts are decaying wood—whether consisting of logs, fallen boughs or old stumps, and even the lichened or mossy trunks of living trees growing in a moist atmosphere; heaps of dead

leaves, hedge-clippings, old straw heaps and well-matured manure, dead grass on lawns or moorland, mossy rocks by ravines in mountain districts, bogs and heaths are also favoured by some species. Living leathery fungi form the food of a few species, and some have been found growing even on bare earth.

Many species occur almost throughout the year when the weather is moist and genial, but usually each has a special season in which sporangia are produced, whether it be summer, autumn, winter or spring.

About 260 species are recognised at the present time; of these 181 have been recorded as British, an addition of 35 to the number included in the last edition of this Guide in 1909.

A few notes may be given on the cultivation of Mycetozoa, on collecting and preserving them, and on mounting them for microscopic examination.

Cultivation of Plasmodium. *Badhamia utricularis* is common in many parts of Britain; the plasmodium feeds on leathery fungi growing on old logs and stumps, and can easily be cultivated indoors in a damp atmosphere. To keep the cultivation healthy, it is well to feed it regularly with fresh moist fungus and remove the pieces of fungus that have been fed on. As long as a supply of food is provided, so long, apparently, will the plasmodium creep and grow; when the food is exhausted it passes into the fruiting stage. If the cultivation is allowed to dry, the plasmodium contracts and assumes the sclerotium condition, in which stage it retains vitality for years. A convenient way to secure a store of sclerotium is to lay pads of wet blotting-paper on the plasmodium; the latter surges on to the blotting-paper in search of food, and pad after pad covered with plasmodium can be removed and allowed to dry slowly. To revive a little of the sclerotium so formed, small pieces a few millimeters across may be cut off and floated in a saucer of water; after a few hours the water should be renewed to remove a yellow substance given off by the reviving sclerotium, which is injurious to its development. In the course of about eight to twelve hours the fragments of sclerotium will have passed into the plasmodium stage and begin to creep under water, when they may be transferred with a pipette to a cover glass; if this is inverted over a moist cell the plasmodium will soon recover the shock of transit, and the rhythmic circulation can be watched at leisure under a microscope.

Cultivation of Swarm-cells. It is often easy to see the emergence of the swarm-cells from the spores and the formation of flagellated zoospores, by simply keeping the spores in water under a cover-slip, or in a "hanging-drop" preparation. In some species, such as *Reticularia Lycoperdon* or *Stemonitis fusca*, the spores will often hatch in a few hours after being placed in water; in others the process is much slower. In order to watch the swarm-cells catch bacteria, divide and ultimately form plasmodia, it is needful that they should be fed with a nutritive solution, such as a decoction of hay or

cabbage. Such cultivations are by no means always successful, as the bacteria are apt to get the upper hand and devour the swarm-cells.

Collecting. When starting out to collect Mycetozoa it is well to be provided with a knife, a pocket lens, and a basket or tin in which small boxes may be packed. Some boxes should be lined with cork to which fragile specimens may be securely pinned and preserved from injury. Immature sporangia should be packed with damp moss or leaves (care being taken that nothing touches them) and thus kept moist till they are quite ripe. After a few hours some ventilation should be given to hinder the growth of mould. When found in the plasmodium stage, they are so sensitive to any disturbance that, in spite of all care in packing, they often either fail to develop or form into abnormal sporangia.

Preservation. When once the sporangia are mature they should be kept dry. If this is done and they are also guarded from the attacks of insects, they may be preserved perfectly for almost any length of time. In this country all that is needful is to keep them in a dry cabinet with a supply of naphthaline. A convenient way of storing specimens is to glue them to cardboard trays turned up at the ends, fitted into pasteboard boxes; the trays can be easily taken out and the specimens examined under a microscope. For identification of the species by microscopic examination, a sporangium should be laid on a glass slide and moistened with methylated spirit, to drive out the air from among the spores; then, after adding a drop of water, with the aid of mounted needles the spores can be gently shaken out and freed from the capillitium, and the characters of the latter observed. For making permanent mountings glycerine jelly is the best medium for most species, as it does not cause shrinking of the spores, whose size and markings are often characteristic; unfortunately the calcareous granules embedded in the sporangium wall and in the "lime-knots" of the capillitium in the *Calcarineæ* are sooner or later dissolved in the jelly, as they are in almost all mounting media.

A satisfactory varnish for ringing the cover-slip is first a layer of Hollis' glue (i.e. shellac dissolved in alcohol), followed, after that has dried, by a layer of gold size. The first varnish alone is brittle and cracks off in time; gold size used alone is too fluid and penetrates the jelly.

In three genera—*Cribraria*, *Dictydium*, *Lindbladia*—a characteristic feature is the presence of minute "plasmodic granules" embedded in the sporangium walls, which vary in size and colour in the different species; these granules dissolve in glycerine jelly, but are well preserved in Canada balsam, which should therefore be used for making permanent mountings of any sporangia belonging to these genera.

The measurements of the spores in the descriptions of species are expressed in terms of thousandths of a millimetre or "microns," symbolised by the Greek letter μ. The colour of the spores is given as they appear when magnified 600 diameters; the markings of the spore-wall as seen when magnified 900 times.

SYNOPSIS OF THE ORDERS AND GENERA OF THE BRITISH MYCETOZOA.

SUBCLASS I.—EXOSPOREÆ. Spores developed outside the sporophore.

Order I. — CERATIOMYXACEÆ. Sporophores membranous, branched; spores white, borne singly on filiform stalks arising from the areolated sporophore.

Genus 1. *Ceratiomyxa* (p. 18).

SUBCLASS II.—ENDOSPOREÆ. Spores developed inside the sporangium.

COHORT I.—*AMAUROSPORALES.* Spores violet-brown or purplish grey (ferruginous in *Stemonitis ferruginea* and *S. flavogenita*, colourless in *Echinostelium*).

Subcohort I.—*CALCARINEÆ.* Sporangia provided with lime (calcium carbonate).

Order I.—PHYSARACEÆ. Lime in the form of minute round granules embedded in the sporangium-wall.

A. Capillitium charged with lime throughout.

Genus 2. *Badhamia* (p. 18).

B. Capillitium of hyaline threads with lime-knots (see Introduction, p. 12).

Genus 3. Sporangia single, subglobose or plasmodiocarps; capillitium without free hooked branches. *Physarum* (p. 21).

Genus 4. Sporangia forming an æthalium. *Fuligo* (p. 26).

Genus 5. Plasmodiocarps; capillitium with free hooked branches. *Cienkowskia* (p. 27).

Genus 6. Sporangia goblet-shaped or ovoid; stalks cartilaginous. *Craterium* (p. 27).

Genus 7. Sporangia ovoid, shining, clustered; stalks membranous. *Leocarpus* (p. 28).

C. Capillitium without lime.

Genus 8. Sporangium-wall opaque. *Diderma* (p. 28).

Genus 9. Sporangium-wall hyaline. *Diachæa* (p. 31).

Order II.—DIDYMIACEÆ. Lime in crystals deposited usually outside the sporangium-wall.

Genus 10. Crystals stellate; sporangia single.
Didymium (p. 32).

Genus 11. Crystals stellate; sporangia forming an æthalium.
Mucilago (p. 34).

Genus 12. Crystals lenticular. *Lepidoderma* (p. 34).

Genus 13. Crystals few, minute, polygonal.
Leptoderma (p. 35).

Subcohort II.—*AMAUROCHÆTINEÆ*. Sporangia without lime.

Order I.—COLLODERMACEÆ. Sporangia with an outer gelatinous wall.

Genus 14. Sporangia usually scattered, sessile.
Colloderma (p. 35).

Order II.—STEMONITACEÆ. Sporangium-wall membranous or evanescent; sporangia usually stalked and provided with a columella.

A. Sporangium-wall evanescent.

Genus 15. Capillitium spreading from the columella and forming a superficial net. *Stemonitis* (p. 36).

Genus 16. Capillitium as above, but not forming a flat superficial net. *Comatricha* (p. 37).

Genus 17. Capillitium springing from the apex of the sporangium. *Enerthenema* (p. 40).

B. Sporangium-wall more or less persistent.

Genus 18. Capillitium radiating from the columella.
Lamproderma (p. 40).

Genus 19. Capillitium threads pale, branched, attached at the tips to membranous discs. *Clastoderma* (p. 42).

Genus 20. Capillitium scanty, colourless, branching from a short columella; sporangia very minute. *Echinostelium* (p. 42).

Order III.—AMAUROCHÆTACEÆ. Sporangia combined into an æthalium.

Genus 21. Capillitium irregularly branched.
Amaurochaete (p. 43).

Genus 22. Capillitium with chambered vesicles.
Brefeldia (p. 43).

COHORT II.—*LAMPROSPORALES.* Spores variously coloured, not violet (except in *Cribraria violacea*).

Subcohort I.—*ANEMINEÆ.* Capillitium wanting, or not forming a system of uniform threads.

Order I.—HETERODERMACEÆ. Sporangium-wall membranous, beset with microscopic round plasmodic granules.

Genus 23. Sporangia æthalioid, the wall not forming a persistent net. *Lindbladia* (p. 44).

Genus 24. Sporangium-wall forming a persistent net. *Cribraria* (p. 44).

Genus 25. Sporangium-wall forming numerous parallel ribs. *Dictydium* (p. 45).

Order II.—LICEACEÆ. Sporangia scattered; walls cartilaginous or membranous, without plasmodic granules.

Genus 26. Sporangia sessile with cartilaginous walls. *Licea* (p. 46).

Genus 27. Sporangia sessile, opening with a membranous lid. *Hymenobolus* (p. 47).

Genus 28. Sporangia stalked, opening with a membranous lid. *Orcadella* (p. 47).

Order III.—TUBULINACEÆ. Sporangia clustered; walls membranous, without microscopic round plasmodic granules.

Genus 29. Sporangia tubular, compacted. *Tubifera* (p. 47).

Order IV.—RETICULARIACEÆ.—Sporangia closely compacted and usually forming an æthalium; true capillitium none, or in *Liceopsis* consisting of a few branching threads and strands.

Genus 30. Sporangia columnar, inner walls reduced to straight slender threads. *Dictydiæthalium* (p. 48).

Genus 31. Sporangia interwoven, inner walls reduced to broad or columnar strands. *Enteridium* (p. 48).

Genus 32. Sporangia interwoven, inner walls laciniated. *Reticularia* (p. 49).

Genus 33. Sporangia subglobose, crowded, inner walls complete. *Liceopsis* (p. 49).

Order V.—LYCOGALACEÆ. Sporangia forming an æthalium; capillitium consisting of branched colourless tubes.

Genus 34. *Lycogala* (p. 49).

Subcohort II.—*CALONEMINEÆ*. Capillitium present; a system of uniform threads.

Order I.—TRICHIACEÆ. Capillitium of free elaters, or an elastic network, with spiral or ring-shaped thickenings.

Genus 35. Elaters free, spirals distinct. *Trichia* (p. 50).

Genus 36. Elaters free, scanty, spirals obscure. *Oligonema* (p. 52).

Genus 37. Capillitium forming a web or network; spirals distinct. *Hemitrichia* (p. 53).

Genus 38. Capillitium with ring-shaped thickenings only. *Cornuvia* (p. 54).

Order II.—ARCYRIACEÆ. Capillitium a profuse network of tubular threads (usually scanty and free in *Perichæna populina*), thickened with cogs, half rings, spines or warts.

Genus 39. Sporangia stalked, sporangium-walls evanescent above. *Arcyria* (p. 55).

Genus 40. Sporangia sessile, clustered, the walls single, persistent. *Lachnobolus* (p. 56).

Genus 41. Sporangia sessile, the walls usually double. *Perichæna* (p. 57).

Order III.—MARGARITACEÆ. Capillitium of solid threads coiled and hairlike, or straight and attached to the sporangium-wall.

Genus 42. Capillitium profuse, coiled. *Margarita* (p. 58).

Genus 43. Capillitium straight. *Dianema* (p. 58).

Genus 44. Capillitium penicillate, spirally banded. *Prototrichia* (p. 59).

MYCETOZOA* DE BARY.

[*MYXOMYCETES*† WALLROTH.]

SUBCLASS I.—EXOSPOREÆ.

ORDER I.—CERATIOMYXACEÆ.

GENUS 1. **CERATIOMYX'A** Schroeter.—Surface of sporophores mapped out into polyhedral spaces, from the centre of each of which arises a slender stalk bearing a single ellipsoid spore. Name Gr. *keras* antler, *muxa* slime.

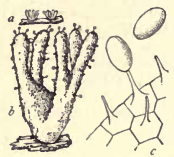

Fig. 9.
CERATIOMYXA FRUTICULOSA Macbr.
a. Clusters of sporophores. Twice natural size.
b. Sporophore. Magnified 40 times.
c. Four areolæ of mature sporophore; one spore still attached to its stalk, and another free. Magnified 480 times.

1. **C. fruticulo'sa** Macbr. — Sporophores white or pinkish-yellow, forming either simple or branching tufts. Spores white, ellipsoid, smooth, 10 × 6 to 13 × 7 μ diam. Name from Latin *fruticulus* a small bush.

Var. **porioi'des** Lister.—Sporophores forming a network resembling the fruiting surface of a *Polyporus*. Name from *Poria* a genus of fungi.

Hab. Common in summer on rotten logs.

SUBCLASS II.—ENDOSPOREÆ.

COHORT I.—*AMAUROSPORALES.*

SUBCOHORT I.—*CALCARINEÆ.*

ORDER I.—PHYSARACEÆ.

GENUS 2. **BADHAM'IA** Berkeley. — Sporangium-wall membranous, containing lime-granules; capillitium a coarse network charged throughout with granules of lime; spores clustered or free. Named after the Rev. C. D. Badham, M.D., 1806 to 1857, a writer on fungi.

* *Spores clustered*

1. **B. capsulif'era** Berk. — Plasmodium yellow. Sporangia globose or pyriform, loosely clustered, sessile or on short membranous stalks, 1 to 1·5 mm. diam., greyish white. Capillitium of broad, branching, anastomosing white bands.

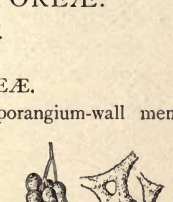

Fig. 10.
BADHAMIA UTRICULARIS Berk.
a. Cluster of sporangia. Magnified 3½ times.
b. Fragment of capillitium and spore-cluster. Magnified 140 times.

* From Greek *mukes* fungus, *zo'on* animal.
† From Greek *muxa* slime, *mukes* fungus.

Spores dark purple-brown, adhering in clusters of 8 to 20, more strongly warted on the outer third, 11 to 13 μ diam. Name L. *capsula* a little case, *fero* I bear.

Hab. On fir logs, etc., autumn and winter.

2. **B. populi'na** Lister.—Plasmodium white. Sporangia white, subglobose, 1·5 mm. diam., crowded, sessile. Capillitium rigid, white. Spores 11 μ diam., in clusters of about 20, dark purple-brown, traversed by a narrow raised band, minutely spinulose, spines closer on one side. Name from L. *populus* a poplar.

Hab. On the bark of dead poplars; autumn and winter.

3. **B. utricular'is** Berk. — Plasmodium orange. Sporangia ovoid, subglobose, or lobed, 0·7 to 1 mm. diam., clustered, with membranous yellow branching stalks, or sessile, cinereous or iridescent grey. Capillitium white. Spores bright brown, in loose clusters of 7 to 10, equally spinulose all over, 9 to 12 μ diam. Name from L. *utriculus* a small bag.

Hab. On old stumps, feeding on woody fungi; autumn to spring.

4. **B. ni'tens** Berk.—Plasmodium yellow. Sporangia subglobose, crowded, sessile, 1 mm. diam., golden or greenish yellow. Capillitium orange-yellow. Spores in close clusters of 6 to 10, purple-brown, coarsely warted on the outer third, 10 to 13 μ diam. Name L. shining.

Var. **reticula'ta** G. Lister. — Sporangia forming simple or branched plasmodiocarps. Name from L. *reticulum* a small net.

Hab. On rotten logs; autumn to spring.

5. **B. versic'olor** Lister.—Plasmodium watery. Sporangia subglobose, sessile, minute, 0·3 to 0·5 mm. diam., often crowded, grey or flesh-colour. Capillitium white or apricot colour. Spores ovoid, 12 × 9 μ diam., in clusters of 10 to 40, dull purple and minutely warted on the broad end, nearly colourless and smooth elsewhere. Name L. particoloured.

Hab. On lichen on tree trunks, 5 or 6 feet from the ground; summer and autumn, rare.

** *Spores free*

6. **B. deci'piens** Berk.—Sporangia subglobose or curved plasmodiocarps, 0·4 to 0·7 mm. diam., yellow or ochraceous, rugose. Capillitium rigid, orange-yellow. Spores free, 11 to 12 μ diam., purple-brown, spinulose. Name L. deceiving, from its resemblance to *B. nitens*.

Hab. On dead wood; rare.

7. **B. macrocar'pa** Rost.—Plasmodium white. Sporangia subglobose, sessile, or oftener with firm pale stalks, gregarious, 0·5 to 1 mm. diam., white. Capillitium white. Spores free, dark purple-

brown, minutely and closely spinulose, 11 to 15 μ diam. Name Gr. *makros* large, *karpos* fruit.

Hab. On logs; autumn and winter, frequent.

8. **B. affi'nis** Rost.—Sporangia gregarious or scattered, greyish-white, about 0·5 mm. diam., stalked or sessile, sometimes forming plasmodiocarps. Stalk black, or black below and whitish above, 0·1 to 0·7 mm. in length. Capillitium white. Spores lilac-brown, minutely spinulose, 10 to 15 μ diam. Name L. allied, from its resemblance to *B. capsulifera*.

Hab. On the mossy bark of living trees; summer and autumn, not common.

9. **B. panic'ea** Rost. — Plasmodium white. Sporangia subglobose, sessile on a red-brown hypothallus, crowded, 1 mm. diam., white or grey, rugose. Capillitium white, with occasional narrow hyaline threads. Spores free, violet-brown, nearly smooth, 11 μ diam. Name L. made of bread, from the look of the empty sporangia.

Hab. On bark of felled elms, etc.; from August to May.

10. **B. foliic'ola** Lister.—Plasmodium orange. Sporangia subglobose, 0·7 mm. diam., iridescent grey, sessile or on slender stalks 0·2 to 0·5 mm. long. Capillitium white, slender, and with lime scanty. Spores free, violet-brown, minutely spinulose, 11 μ diam. Name L. *folium* leaf, *colo* I inhabit.

Hab. On grass, dead leaves and twigs; from summer to winter.

11. **B. ovis'pora** Racib.—Sporangia white or pale ochraceous, hemispherical, 0·5 mm. diam., or irregular plasmodiocarps, crowded or scattered. Sporangium-wall thick, fragile. Capillitium white, coarse, often forming a columella, fragile, with the lime granules loosely adhering. Spores free, purple-brown, ellipsoid, 10 × 8 to 16 × 10 μ diam., smooth, traversed lengthwise by a narrow raised band. Name L. *ovum* egg, Gr. *spora* spore, from the oval spores.

Hab. On old straw; summer and autumn, not common.

12. **B. lilaci'na** Rost.—Plasmodium lemon-yellow. Sporangia subglobose, sessile, crowded, 0·5 mm. diam., pale flesh-coloured. Capillitium pale flesh-coloured. Spores free, dark purple-brown, reticulated with prominent and confluent warts, 11 to 13 μ diam. Name Mod. L. lilac.

Hab. On decayed stumps and bog moss; autumn.

13. **B. rubi'gino'sa** Rost.—Plasmodium yellow. Sporangia obovoid, rufous-brown, pale above. Stalk rufous. Columella half the height of the sporangium. Capillitium pale rufous. Spores free, dark purple-brown, 11 to 15 μ diam., minutely spinulose. Name L. rusty, from the colour of the sporangia.

Var. **dictyos'pora** Lister.—Resembling the typical form, except that the spores are marked with prominent confluent warts or reticulate. Name Gr. *diktuon* a net, *spora* spore, from the spore markings.

Var. **globo'sa** Lister. — Sporangia subglobose, somewhat depressed, 0·7 mm. broad, purplish grey. Stalk dark brown, 0·5 to 1 mm. long. Columella dark brown, clavate. Spores strongly reticulate and warted. Name L. globular.

Hab. Var. *dictyospora* on dead leaves and brushwood; var. *globosa* on moss on wet rocks; autumn. Typical form not found in Britain.

GENUS 3. **PHY'SARUM** Persoon.—Sporangium-wall membranous, with innate deposits of lime in round granules, either in clusters or densely compacted and chalky. Capillitium a network of delicate threads, with vesicular expansions filled with lime granules (lime-knots). Name from Gr. *phusa* a bladder or bubble, from the appearance of the sporangia.

* *Sporangia usually stalked*

1. **P. leu'copus** Link.— Plasmodium milk-white. Sporangia globose, gregarious, 0·5 mm. diam., glaucous-cinerous; stalk stout, chalk-white in section throughout. Columella none. Capillitium white; lime-knots large. Spores violet-brown, nearly smooth, 7 to 10 μ diam. Name Gr. *leukos* white, *pous* a foot.

Hab. On dead leaves, etc.; autumn and winter.

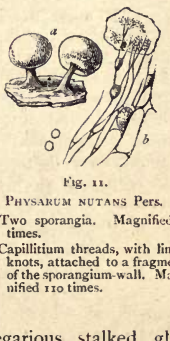

Fig. 11.

PHYSARUM NUTANS Pers.

a. Two sporangia. Magnified 9 times.

b. Capillitium threads, with lime-knots, attached to a fragment of the sporangium-wall. Magnified 110 times.

2. **P. globulif'erum** Pers.—Sporangia gregarious, stalked, globose, white, 0·5 mm. diam. Stalk white or buff, charged with lime throughout. Columella conical. Capillitium persistent, with small white lime-knots. Spores lilac-brown, nearly smooth, 6 to 8 μ diam. Name L. *globulus* a globule, *fero* I bear.

Hab. On dead wood; autumn, rare.

3. **P. muri'num** Lister. — Sporangia subglobose, stalked or sessile, pale brown, 0·5 mm. diam. Stalk brown, charged with lime throughout. Columella conical. Capillitium persistent, with brown lime-knots. Spores violet-brown, nearly smooth, 8 to 10 μ diam. Name L. mouse-like, from the brown sporangia.

Hab. On dead wood and leaves; autumn, rare.

4. **P. pulcher'ripes** Peck.—Like *P. murinum* but with orange sporangia and lime-knots, and red-brown stalks. Name L. *pulcher* beautiful, *pes* foot.

Hab. On dead wood; autumn, rare.

5. **P. citrinum** Schum.—Sporangia subglobose, gregarious, 0·4 to 0·7 mm. diam., yellow. Stalk stout, yellow, charged with lime throughout. Columella conical. Capillitium persistent; lime-knots

yellow. Spores violet-brown, almost smooth, 7 to 8 μ diam. Name from L. *citrus*, lemon.

Hab. On dead wood and moss; summer and autumn.

6. **P. lu'teo-al'bum** Lister.—Sporangia gregarious, stalked, subglobose, yellow, orange or olivaceous, about 1 mm. diam. Stalk stout, yellow above, white below, 0·5 to 1 mm. in length, charged with lime throughout. Columella large, subglobose, yellow or orange. Capillitium of straight, sparingly-branched threads, with few very slender yellow lime-knots. Spores purple-brown, strongly spinulose, 10 to 12 μ diam. Name L. *luteus* yellow, *albus* white.

Hab. On dead leaves beneath alders, etc.; winter and spring.

7. **P. muta'bile** Lister.—Sporangia white, rugose; ovoid, 0·4 to 0·6 mm. diam., erect, seated on an ochraceous hypothallus which is often produced into a short ochraceous stalk, or forming plasmodiocarps. Stalk buff, stout or slender, often enclosing lime granules. Capillitium a persistent network of hyaline threads; lime-knots mostly confluent in the centre of the sporangium and forming an elongate clavate pseudo-columella. Spores purple-brown, spinulose, 8 to 10 μ diam. Name L. variable.

Hab. On straw and rotting herbaceous stems; summer and autumn.

8. **P. nuclea'tum** Rex.—Sporangia gregarious, stalked, globose, white, 0·5 mm. diam. Stalk slender, pale yellow or buff, translucent, 0·7 to 1·5 mm. long. Columella none. Capillitium a persistent network of very slender threads; lime-knots chiefly concentrated to form a central white ball. Spores lilac-brown, minutely spinulose, 6 to 7 μ diam. Name from L. *nucleus* a little nut, from the calcareous ball in the midst of the capillitium.

Hab. On dead wood; summer, rare.

9. **P. psittaci'num** Ditm.—Plasmodium orange-yellow. Sporangia subglobose, gregarious, 0·5 mm. diam., glossy, purple or metallic green mottled with red. Stalk orange-red, translucent. Columella none. Capillitium with bright orange lime-knots. Spores dull violet, nearly smooth, 7 to 8 μ diam. Name L. parrot-like.

Hab. On old stumps; summer and early autumn, not uncommon.

10. **P. penetra'le** Rex.—Plasmodium orange-yellow. Sporangia ellipsoid or globose, 0·4 to 0·6 diam., smooth, grey. Stalk slender, translucent, solid, pale red, continued as a columella three-fourths the height of the sporangium. Capillitium slender, with small yellow lime-knots. Spores pale violet-brown, 6 μ diam. Name L. penetrating, from the long columella.

Hab. On liverworts and dead wood; summer and autumn.

11. **P. car'neum** G. Lister & Sturgis.—Plasmodium bright yellow. Sporangia gregarious, usually stalked, subglobose, yellow-buff, or olive-grey from lack of lime, 0·4 to 0·6 mm. diam. Stalk

flesh-colour or reddish brown. Capillitium of fragile branching whitish lime-knots with short connecting threads. Spores spinulose, purple-brown, paler on one side, 8 μ diam. Name L. of flesh, from the colour of the stalk.

Hab. On dead wood; summer, rare.

12. **P. brun'neolum** Massee.—Plasmodium yellow. Sporangia scattered, subglobose, shortly stalked, sessile, or forming plasmodiocarps, yellow-brown, glossy, the stout walls often opening in revolute lobes. Stalk brown or black. Capillitium a network of threads with many large branching white lime-knots. Spores purple-brown, spinulose, 8 to 10 μ diam. Name diminutive from mediæval L. *brunneus* brown.

Hab. On dead wood, herbaceous stems and leaves; summer, rare.

13. **P. vir'ide** Pers.—Plasmodium yellow. Sporangia lenticular or subglobose, nodding, scattered, 0·5 mm. diam., yellow or greenish. Stalk subulate, yellow, grey or brown, containing refuse matter in the lower part. Capillitium slender; lime-knots fusiform, orange. Spores violet-brown, nearly smooth, 7 to 10 μ diam. Name L. green.

Var. **auran'tium** Lister.—Sporangia and lime-knots orange. Name Mid. Latin orange.

Var. **inca'num** Lister.—Sporangia pale grey, lime-knots yellow. Name L. hoary.

Hab. On rotten stumps; common in summer and autumn.

14. **P. gal'beum** Wing.—Plasmodium yellow. Sporangia subglobose, 0·5 mm. diam., yellow. Stalk translucent, yellow throughout or red below. Capillitium slender with flat expansions at the axils and numerous yellow angular lime-knots. Spores pale violet-brown, 7 μ diam. Name L. yellow.

Hab. On dead bramble twigs, etc.; autumn, not common.

15. **P. auriscal'pium** Cooke.—Sporangia subglobose, stalked or sessile, yellow or orange, rugose, 0·4 to 0·8 mm. diam. Stalk short, red or dark brown. Capillitium of large branching orange lime-knots connected by short hyaline threads. Spores violet-brown, minutely spinulose, 9 to 12 μ diam. Name L. ear-pick.

Hab. On dead wood, twigs and moss; autumn, not common.

16. **P. nu'tans** Pers.—Plasmodium watery-white. Sporangia lenticular or subglobose, erect or nodding, gregarious, 0·4 to 1 mm. diam., pale grey. Stalk subulate, straw-coloured, grey or dark, containing refuse matter below. Capillitium slender, with flat expansions at the axils; lime-knots small, white; spores violet-brown, nearly smooth, 8 to 11 μ diam. Name L. nodding.

Var. **leucophæ'um** Lister.—Sporangia erect or plasmodiocarps, sometimes limeless. Stalks stouter, dark. Capillitium with larger lime-knots. Name Gr. *leukos* white, *phaios* dusky.

Var. **robus'tum** Lister.—Sporangia erect, often forming plasmodiocarps. Stalks white or grey. Capillitium more rigid, with large branching lime-knots. Name L. robust.

Hab. On dead wood, rarely on leaves; common from summer to early spring.

17. **P. craterifor'me** Petch.—Sporangia scattered or in groups, stalked, subglobose or reniforme, rarely obovoid, greyish white. Stalk black. Columella white, cylindrical, conical or absent. Capillitium of white branching lime-knots with short connecting threads. Spores violet-brown, closely and minutely spinulose, 8 to 13 μ diam. Name L. *crater* cup, *forma* shape.

Hab. On mossy trunks of living trees, or on dead wood; summer and autumn, rare.

18. **P. pusil'lum** Lister.—Sporangia subglobose, or scattered, about 0·5 mm. diam., white. Stalk dark red, translucent. Capillitium-threads slender; lime-knots white, irregular in shape and size. Spores pale brownish violet, nearly smooth, 8 to 11 μ diam. Name L. small.

Hab. On dead leaves, straw, etc.; frequent from summer to winter.

19. **P. compres'sum** Alb. & Schw.—Plasmodium white. Sporangia subglobose or lobed, compressed, often clustered; stalked, sessile or plasmodiocarps, grey or white. Stalk dark or white, containing refuse matter. Capillitium-threads terete, flexuose; lime-knots white, rounded, numerous. Spores dark purplish brown, spinulose, 9 to 14 μ diam. Name L. compressed.

Hab. On dead wood, bark, straw and leaves. A very variable species, frequent throughout the year.

20. **P. conna'tum** Lister.—Very similar to *P. compressum*, but with subglobose not compressed sporangia, and more angular lime-knots. Name L. *con* together, *natus* born, from the sporangia being often united in small clusters.

Hab. On dead wood; not common.

21. **P. stramin'ipes** List.—Plasmodium white. Allied to *P. compressum*, differing in the stalks, which, when present, are often long, slender, of a pale straw colour and free from refuse matter, also in the more rigid capillitium, and in the sculpture of the spores, on which the warts are crowded in broad patches separated by smooth tracts. Name L. *stramen* straw, *pes* foot.

Hab. On old straw and dead leaves; not uncommon throughout the year.

22. **P. didermoi'des** Rost.—Plasmodium white. Sporangia ovoid, erect, stipitate, crowded, 0·5 mm. diam.; sometimes subglobose and sessile, white, or dark grey from the falling away of the outer calcareous crust from the purplish inner wall. Stalk short, white, membranous, free from refuse matter. Capillitium-threads terete,

connecting numerous rounded lime-knots. Spores very dark purple-brown, closely and minutely spinulose, 10 to 13 μ diam. Name Gr. *dis* (*di*) double, *derma* skin, from the double sporangium-wall.

Var. **liv'idum** Lister differs from the type in the sporangia being always sessile and subglobose, grey, with usually a single sporangium-wall, and also in the rougher purple-black spores being paler on one side. Name L. livid.

Hab. On old straw and dead leaves; not common; from summer to winter.

** *Sporangia sessile*

23. **P. ciner'eum** Pers.—Plasmodium white. Sporangia sessile, subglobose, or slender plasmodiocarps, scattered or crowded, 0·3 to 0·5 mm. diam., pale grey. Capillitium with numerous white simple or branched lime-knots. Spores violet-brown, nearly smooth, 7 to 10 μ diam. Name L. ashy.

Hab. On dead leaves; common, especially in autumn.

24. **P. ver'num** Somm.—Closely allied to *P. cinereum*, but more robust, and with darker rougher spores, 10 to 12 μ diam. Name L. vernal.

Var. **irides'cens** G. Lister.—Sporangia shining dark brown from absence of lime in the walls; capillitium with abundant angular lime-knots enclosing large lime granules; spores purple-brown, paler on one side.

Hab. On old straw and dead leaves; common throughout the year.

25. **P. sinuo'sum** Weinm. — Plasmodium white. Sporangia sessile, elongate, laterally compressed, wall-like, straight or flexuose, splitting longitudinally, white or buff. Capillitium of numerous white lime-knots connected by short hyaline threads. Spores violet-brown, spinulose, 8 to 10 μ diam. Name L. curved.

Hab. On dead leaves and twigs; frequent, summer to winter.

26. **P. bitec'tum** Lister.—Closely allied to *P. sinuosum*, but with the white outer sporangium-wall peeling off and disclosing the purplish inner layer; capillitium with larger white lime-knots. Spores purplish brown, paler on one side, spinulose, 10 to 12 μ diam. Name L. *bis* (*bi*) twice, *lectum* covered.

Hab. On dead leaves and twigs; frequent, especially in autumn and winter.

27. **P. contex'tum** Pers.—Plasmodium yellow. Sporangia sessile, subglobose, or curved, crowded, 0·5 mm. diam., ochraceous, the wall densely calcareous. Capillitium of numerous branching white lime-knots with short connecting threads. Spores dark violet-brown, spinulose, 10 to 13 μ diam. Name L. woven together, from the clustered sporangia.

Hab. On dead leaves and twigs; frequent from summer to winter.

28. **P. conglomera'tum** Rost.—This species resembles *P. contextum* in general appearance, but differs in the spores, which are pale violet-brown, nearly smooth, 8 to 10 μ diam. Name L. *con* together, *glomerare* to collect.

Hab. On dead leaves and twigs, throughout the year; less frequent than *P. contextum*.

29. **P. laterit'ium** Morgan.—Sporangia gregarious, sessile, or forming slender simple or branched plasmodiocarps, orange- or brick-red. Capillitium a network of fragile threads, with yellow or orange rounded lime-knots. Spores lilac-brown, almost smooth, 6 to 9 μ diam. Name L. of bricks, from the red sporangia.

Hab. On dead wood, twigs and leaves; summer, rare.

30. **P. vires'cens** Ditm.—Plasmodium yellow. Sporangia sessile, irregularly ovoid, 0·2 to 0·3 mm. diam., aggregated in clusters, rugose, yellowish green. Capillitium delicate, flexuose, often scanty, lime-knots yellow. Spores pale violet-brown, nearly smooth, 6 to 9 μ diam. Name L. becoming green.

Var. **obscu'rum** Lister.—Sporangia more scattered, smooth, olive-brown, often forming plasmodiocarps, 0·5 mm. diam. Name L. dark.

Var. **ni'tens** Lister.—Sporangia gregarious, not clustered, bright yellow, 0·5 to ·08 mm. diam. Name L. bright.

Hab. On dead leaves, etc., in summer and autumn.

GENUS 4. **FULI'GO** Haller.—Æthalium consisting of interwoven anastomosing sporangia enclosed in a barren cortex. Name L. soot.

Fig. 12.—FULIGO SEPTICA Gmel.
a. Æthalium. One-third natural size.
b. Capillitium threads with lime-knots and two spores. Magnified 120 times.

1. **F. sep'tica** Gmel. — Plasmodium yellow. Æthalia pulvinate, from 2 mm. to 20 cm. broad, yellow. Sporangium-walls within the æthalium containing scattered innate deposits of lime. Capillitium of hyaline threads with yellow lime-knots. Spores violet, nearly smooth, 6 to 10 μ diam. Name Gr. *septikos* decaying.

Var. **can'dida** Lister.—Plasmodium and æthalium white. Name L. white.

Var. **ru'fa** Lister.—Plasmodium cream colour, æthalium brick-red. Name L. red.

Hab. On rotten wood, tan, etc. Common in summer.

2. **F. musco'rum** Alb. & Schw.—Plasmodium orange. Æthalia pulvinate, nearly smooth, ochraceous or grey flecked with yellow, about 1 cm. long. Cortex obsolete. Hyaline threads of the capillitium scanty; lime-knots abundant, angular and branching, dull yellow or orange. Spores violet-brown, spinulose, 10 to 11 μ diam. Name L. *muscus* moss.

Hab. On rushes, moss, etc., in moist places; autumn, not common.

3. **F. cine'rea** Morgan.—Æthalia pulvinate, rounded or elongate, 2 to 6 cm. long, white. Cortex even, densely calcareous, or obsolete. Capillitium pure white, either *Badhamia*-like or with broad irregular lime-knots connected by hyaline threads. Spores elliptical or nearly spherical, purple-brown, spinulose, usually 12 to 14 by 8 to 10 μ diam. Name L. ashy.

Var. **ecortica'ta** Lister.—Æthalia of loosely combined sporangia, without cortex; spores globose. Name L. *e* without, *cortex* bark.

Hab. On old straw and dead leaves; summer and autumn.

GENUS 5. **CIENKOW'SKIA** Rostafinski.—Sporangium-wall cartilaginous at the base. Capillitium a loose network of rigid threads, with many free curved sharp-pointed branchlets, connected with vertical flat perforated calcareous plates attached at their margins to the sporangium-wall. Named after Dr. L. S. Cienkowski, 1822 to 1887, a Russian botanist.

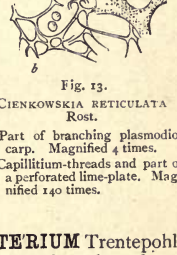

Fig. 13.
CIENKOWSKIA RETICULATA Rost.
a. Part of branching plasmodiocarp. Magnified 4 times.
b. Capillitium-threads and part of a perforated lime-plate. Magnified 140 times.

1. **C. reticula'ta** Rost.—Plasmodiocarps cylindrical, winding, 0·5 mm. diam., usually anastomosing and forming a net, yellow-brown, blotched with crimson. Capillitium-threads yellow; the calcareous plates pale yellow. Spores violet-brown, minutely spinulose, 9 to 11 μ diam. Name L. net-like.

Hab. On dead wood. Rare.

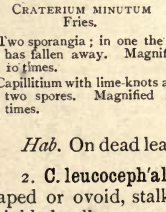

Fig. 14.
CRATERIUM MINUTUM Fries.
a. Two sporangia; in one the lid has fallen away. Magnified 10 times.
b. Capillitium with lime-knots and two spores. Magnified 110 times.

GENUS 6. **CRATE'RIUM** Trentepohl.—Sporangia stalked, goblet-shaped or ovoid, usually dehiscing with a distinct lid; sporangium-wall charged with granules of lime, cartilaginous in the lower part, thinner above. Capillitium containing large lime-knots often confluent in the centre of the sporangium as a pseudo-columella. Name Gr. little cup.

1. **C. minu'tum** Fries.—Plasmodium yellow. Sporangia smooth, goblet-shaped, ochraceous, with a pale lid. Capillitium with many large white lime-knots. Spores violet-brown, nearly smooth, 8 to 9 μ diam. Name L. small.

Hab. On dead leaves. Common, especially in autumn and winter.

2. **C. leucoceph'alum** Ditm.—Plasmodium yellow. Sporangia top-shaped or ovoid, stalked, red-brown, with white mealy deposits and sprinkled yellow granules on the upper half and lid. Capillitium with

large white or yellowish lime-knots. Spores violet-brown, spinulose, 7 to 9 μ diam. Name Gr. *leukos* white, *kephalos* head.

Hab. On dead leaves, frequent in summer and autumn.

3. **C. au'reum** Fr. — Plasmodium lemon-yellow. Sporangia ovoid, stalked, without a distinct lid, yellow, the wall thin, rough with innate clusters of yellow lime granules. Capillitium with pale yellow lime-knots. Spores violet-brown, spinulose, 8 to 9 μ diam. Name L. golden.

Hab. On dead leaves; summer and autumn.

Fig. 15.

LEOCARPUS FRAGILIS Rost.

a. Cluster of sporangia. Magnified 2½ times.

b. Hyaline threads and branching lime-knot of the capillitium, with two spores. Magnified 120 times.

GENUS 7. **LEOCAR'PUS** Link.—Sporangium-wall uniform, of two layers; the outer cartilaginous and calcareous, shining; the inner hyaline. Capillitium a network of hyaline threads combined with branched and anastomosing brownish lime-knots. Name Gr. *leios* smooth, *derma* skin.

1. **L. frag'ilis** Rost. — Sporangia ellipsoid, crowded, chestnut-brown, shining as if varnished, with short membranous stalks. Capillitium as in the genus. Spores violet-brown, 11 to 13 μ diam.

Hab. On dead leaves, etc., frequent from summer to winter.

GENUS 8. **DIDER'MA** Persoon. — Sporangium-wall of two layers (except in *D. simplex*), containing granular deposits of lime. Capillitium without lime-knots. Name Gr. *di* double, *derma* skin.

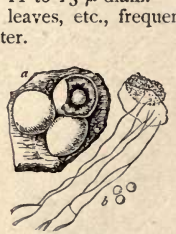

Fig. 16.

DIDERMA TESTACEUM Pers.

a. Group of three sporangia; in the upper one the double wall is broken away in part and the columella exposed. Magnified 9 times.

b. Portion of the outer and inner layers of the sporangium-wall; to the latter the capillitium-threads are attached; three spores. Magnified 170 times.

Subgenus 1. *Eudiderma.*—Sporangia mostly sessile, the outer wall a smooth crust composed of globular lime-granules, the inner membranous.

1. **D. spumarioi'des** Fr. — Plasmodium white. Sporangia subglobose, white, sessile, 0·5 to 1 mm. diam., crowded; the two layers of the wall usually adhering. Hypothallus profuse, rarely wanting. Columella convex, pale. Capillitium of slender purplish flexuose threads. Spores violet-brown, minutely spinulose, 8 to 11 μ diam. Name from *Spumaria*, synonym for *Mucilago*.

Hab. On leaves; common throughout the year.

2. **D. globo'sum** Pers. — Differs from *D. spumarioides* in the outer layer of the sporangium-wall separating more freely from the

inner, and in the larger, darker, more spinulose spores, 10 to 14 μ diam.

Hab. On dead leaves, etc., in autumn; not common.

3. **D. testa'ceum** Pers.— Plasmodium pale buff. Sporangia subglobose, sessile on a broad base, 0·8 mm. diam., pale flesh-coloured; the eggshell-like outer wall of the sporangium separating from the inner. Columella large, hemispherical, reddish brown. Capillitium very slender, nearly colourless. Spores pale violet-brown, nearly smooth, 7 to 8 μ diam. Name L. of tiles, from the reddish sporangia.

Hab. On dead leaves, summer and autumn; not common.

4. **D. hemisphe'ricum** Hornem.—Plasmodium opaque white. Sporangia disc-shaped, white, 1 to 1·2 mm. diam., on stout, pale ochraceous, central stalks, rarely sessile. Columella broad, flat. Capillitium and spores as in *C. testaceum*. Name Gr. *hemi* half, *sphaira* a ball, an inappropriate name.

Hab. On dead leaves, etc.; not very common, appearing at all seasons.

5. **D. effu'sum** Morg.—Plasmodium white. Sporangia sessile, white, hemispherical, flattened, 0·7 mm. diam., or branching plasmodiocarps often forming a net. Capillitium and spores as in *D. hemisphericum*. Name L. poured out, from the flat spreading sporangia.

Hab. On dead leaves; not unfrequent, especially in autumn.

6. **D. arbor'eum** G. Lister & Petch. — Sporangia scattered, discoid, 0·5 mm. diam., white or purplish grey, smooth, sessile or shortly stalked, or forming expanded flattened plasmodiocarps. Stalk dark, stout or slender. Columella convex and flesh-coloured, or absent. Capillitium of simple, or branching and anastomosing, colourless or purplish rather stout threads. Spores 10 to 15 μ diam., pale purplish or purplish brown, minutely spinulose. Name L. arboreal, from the sporangia appearing on living trees.

Hab.—On moss and bark, on trunks of living trees; summer and autumn; apparently rare.

7. **D. deplana'tum** Fr. (*D. niveum*, subsp. *deplanatum*).—Sporangia scattered, pulvinate, 1 mm. diam., or branching plasmodiocarps, white; the outer layer of the sporangium-wall thick, the inner orange membranous. Columella broad, convex, or almost plane, orange. Capillitium dark, somewhat rigid, warted. Spores violet-brown, minutely spinulose, 9 to 11 μ diam. Name L. level.

Hab. On dead leaves and twigs; not uncommon, chiefly in autumn and winter.

8. **D. simplex** Lister.—Plasmodium yellow-brown. Sporangia crowded, reddish clay-colour or buff, sessile, subglobose or irregular in shape and size, about 0·6 mm. diam. Sporangium-wall single, membranous, charged with brown granules. Columella indefinite, rugose. Capillitium slender, colourless, often beaded with scattered

brown granules. Spores brownish violet, minutely warted, 8 to 10 μ diam. Name L. single, from the single layer of the sporangium-wall.

Hab. On boggy moors and on dead leaves; summer and autumn, not common.

Subgenus 2. *Leangium.*—Sporangia mostly stalked; sporangium-wall often dehiscing in revolute lobes; of two usually inseparable layers, the outer cartilaginous, charged with minute granules of lime (except in *D. Trevelyani*), the inner membranous.

9. **D. Trevelya'ni** Fries.—Sporangia roundly ovoid, 1 mm. diam., shortly stalked or sessile, chestnut-brown. The sporangium-wall differs from that in all other species of the subcohort *Calcarineæ* in being constructed of an outer cartilaginous brown layer, a thick middle layer consisting of white crystalline calcareous deposits, and a delicate membranous inner layer, to which the ends of the capillitium are attached. Columella small, subglobose or none. Capillitium a network of purple threads, with dark thickenings at the nodes. Spores dark violet-brown, spinulose, 10 to 12 μ diam. Named after W. C. Trevelyan (1797 to 1879) who first found the species.

Hab. On dead leaves; autumn to spring, not common.

10. **D. Sauter'i** Macbr.—Sporangia subglobose, depressed, sessile, pale pinkish brown; outer layer of sporangium-wall cartilaginous, brittle, separating from the membranous inner layer. Columella indistinct. Capillitium of sparingly branched colourless or grey threads, 2 to 3 μ diam. Spores dark violet-brown, spinulose, 10 to 13 μ diam. Named after Dr. A. E. Sauter (1800 to 1881) who first found the species at Salzburg.

Hab. On dead wood and moss; rare.

11. **D. ochra'ceum** C. F. Hoffm.—Plasmodium lemon-yellow. Sporangia sessile, hemispherical, or curved and sometimes ring-shaped plasmodiocarps, 1 to 2 mm. long, clustered or solitary, ochraceous. Columella indefinite. Capillitium-threads purple, abundant. Spores purplish grey, minutely spinulose, 11 μ diam. Name from Gr. *okhros* yellow earth.

Hab. On moss and liverworts; autumn, rare.

12. **D. radia'tum** Lister.—Plasmodium yellowish white. Sporangia subglobose, umbilicate beneath, about 1 mm. diam., reddish brown, dehiscing in stellate lobes; sporangium-wall cartilaginous, obscurely granular, with an inseparable membranous inner layer. Stalk short, thick, pale brown. Columella hemispherical. Capillitium dark violet-brown, rigid, sparingly branched; spores purplish brown, minutely spinulose, 9 to 12 μ diam. Name L. radiate, from the ray-like lobes of the expanded sporangia.

Var. **umbilica'tum** Meylan.—Sporangia pale drab, dehiscing irregularly. Name L. having a navel-like hollow.

Var. **monta'num** Meylan.—Sporangia white, with the outer wall separating from the inner. Name L. growing on mountains.

Hab. On dead leaves, twigs, etc.; the two varieties are frequent in autumn and winter; the typical form is not common.

13. **D. florifor'me** Pers.—Plasmodium greyish white. Sporangia globose, 0·8 mm. diam., white, buff or brown; sporangium-wall dehiscing on drying in revolute lobes. Stalks cylindrical, brown. Columella ovoid. Capillitium of slender violet-brown threads with bead-like thickenings. Spores red-violet-brown, with widely scattered coarse warts, 9 to 11 μ diam. Name L. *flos* flower, *forma* shape.

Hab. On dead wood and twigs; not uncommon, especially in autumn and winter.

14. **D. asteroi'des** Lister.—Sporangia hemispherical, sessile or shortly stalked, rarely forming plasmodiocarps; purplish brown or chocolate-brown, mottled with darker stripes, dehiscing in stellate revolute lobes. Stalk stout, white or buff. Columella hemispherical, white. Capillitium of slender colourless or purple threads. Spores purple-brown, minutely warted, 10 to 12 μ diam. Name from Gr. *aster* star.

Hab.—On dead leaves; autumn and winter, not common.

15. **D. lu'cidum** Berk. & Br.—Plasmodium yellow. Sporangia subglobose, flattened beneath, orange, shining, 0·8 mm. diam. Sporangium-wall translucent. Stalk subulate, black. Columella subglobose, cream-white. Capillitium of scanty black coarse threads forming a loose network with broad expansions at the axils. Spores dark purplish grey, closely spinulose, 14 μ diam. Name L. shining.

Hab. On mosses on wet rocks; autumn; N. Wales.

GENUS 9. **DIACHÆ'A** Fries.—Lime present in the stalk and columella, entirely absent from the purple capillitium and iridescent sporangium-wall. Name Gr. *diakheo* to melt or fall to pieces, from the fragile sporangia.

1. **D. leucop'oda** Rost.—Plasmodium white. Sporangia cylindrical, rarely globose, 0·25 mm. diam., iridescent purple; stalk white. Columella narrowing upwards, white, giving rise to the closely branching capillitium. Spores dull violet, nearly smooth, 7 to 9 μ diam. Name Gr. *leukos* white, *pous* foot.

Hab. On dead leaves; summer and autumn, frequent.

Fig. 17.

DIACHÆA LEUCOPODA Rost.

Two sporangia, the one entire, the other deprived of the spores and showing capillitium and columella. Magnified 22 times.

2. **D. subses'silis** Peck.—Plasmodium yellow. Sporangia globose, 0·5 mm. diam., iridescent purple. Stem short, thick, white, charged with lime, or dark brown and without lime. Columella short,

conical or obsolete. Capillitium a network of purple-brown or sometimes colourless threads. Spores purplish green with yellow contents, reticulate with rows of minute spines forming about six meshes across the hemisphere, 8 to 10 μ diam. Name L. *sub* slightly, *sessilis* sitting.

Hab. On dead leaves and twigs; autumn, uncommon.

ORDER II.—DIDYMIACEÆ.

GENUS 10. **DIDYM'IUM** Schrader. — Sporangia stalked or sessile; lime-crystals either scattered on the membranous sporangium-wall, or closely combined and forming a crust; capillitium often thickened at intervals with dark nodes. Name Gr. *didumos* double, from the double character of the sporangium-wall.

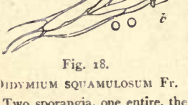

Fig. 18.

DIDYMIUM SQUAMULOSUM Fr.

a. Two sporangia, one entire, the other showing columella and capillitium. Magnified 12 times.

b. Capillitium and fragment of sporangium-wall, with crystals of calcium carbonate and two spores. Magnified 200 times.

* *Superficial crystals closely combined to form a thin eggshell-like crust*

1. **D. diffor'me** Duby.—Plasmodium colourless or yellow. Sporangia white, depressed, pulvinate, on a broad yellowish base, or plasmodiocarps; lime-crystals minute, densely combined to form a smooth, eggshell-like crust, often separating from the iridescent inner sporangium-wall. Columella none. Capillitium scanty, the threads broad at the base, branched above, dark or colourless. Spores dark purple-brown, nearly smooth, 11 to 14 μ diam. Name L. *dis* away, *forma* shape; of unusual shape.

Var. **coma'tum** Lister.—Capillitium profuse, of slender equal threads not thickened at the base, dark or colourless. Name L. having a head of hair.

Hab. On dead leaves; the typical form common throughout the year.

2. **D. tro'chus** Lister.—Plasmodium bright yellow. Sporangia top-shaped, hemispherical, pale ochre or white; the sporangium-wall readily falling off entire, the outer layer eggshell-like, usually adhering to the membranous inner layer. Columella convex, broad, with an orange-brown rim, seated on the dilated apex of the yellowish brown stalk, filled with stellate crystalline masses of lime. Capillitium rigid and persistent, dark or colourless, nearly simple or branched. Spores brownish purple, 9 to 10 μ diam., strongly warted. Name from a genus of top-shaped shells.

Var. **ten'ue** G. Lister.—Sporangia white, hemispherical, depressed, or forming slender plasmodiocarps; columella indefinite. Name L. thin.

Hab. On old straw and dead leaves; throughout the year.

3. **D. du'bium** Rost.—Plasmodium colourless. Sporangia flat, white, rounded, or irregular plasmodiocarps 1 to 12 mm. broad, solitary; lime-crystals large stellate, adhering to form a frosted crust often extending beyond the margin of the broad membranous base of the sporangium. Columella none. Capillitium profuse, of rigid purple-brown erect anastomosing threads, slender above and below. Spores violet-grey, nearly smooth, 8 to 11 μ diam. Name L. doubtful.

Hab. On dead leaves; from autumn to spring, unfrequent.

** *Superficial crystals scattered or loosely combined*

4. **D. complana'tum** Rost. — Plasmodium yellow. Sporangia forming thin, effused, grey plasmodiocarps, 2 to 8 mm. diam. Columella none. Capillitium of slender threads connected with large scattered purplish vesicles, 20 to 50 μ diam., filled with yellowish granular matter. Spores pale violet-brown, nearly smooth, 7 to 9 μ diam. Name L. levelled down.

Hab. On dead leaves and twigs; throughout the year, not common.

5. **D. cla'vus** Rost.—Plasmodium colourless. Sporangia grey, 0·7 to 1 mm. diam., disc-like, on a dark stalk, in shape resembling a flat-headed nail, rarely sessile. Columella indefinite. Capillitium profuse. Spores pale violet-brown, almost smooth, 6 to 8 μ diam. Name L. a nail.

Hab. On dead leaves; frequent throughout the year.

6. **D. melanosper'mum** Macbr.—Plasmodium colourless. Sporangia about 1 mm. diam., hemispherical, deeply umbilicate beneath, grey; sporangium-wall mottled with brown. Stalk and broad columella dark opaque-brown. Capillitium of coarse pale or dark threads. Spores dark purplish grey, spinulose, 9 to 11 μ diam. Name Gr. *melanos* black, *sperma* seed.

Var. **min'us** Lister.—Sporangia smaller, with short stalks and slender capillitium; spores nearly smooth, 7 to 9 μ diam. Name L. less.

Hab. On dead leaves and bark.

7. **D. nig'ripes** Fr.—Distinguished from *D. melanospermum* var. *minus*, in the stalk being longer and more slender, and in being horn-clear instead of opaque and granular. Name L. *niger* black, *pes* foot.

Var. **exim'ium** Lister.—Stalk and columella orange. Name L. notable.

Var. **xan'thopus** Fr.—Stalk orange. Columella white. Name Gr. *xanthos* yellow, *pous* foot.

Hab. On dead leaves; common.

8. **D. squamulo'sum** Fries.—Plasmodium colourless. Sporangia very various, subglobose, hemispherical, stalked, sessile, or effused plasmodiocarps, white or grey; the stellate crystals adhering to form a wrinkled crust, or scattered; stalk short, white, opaque, rarely orange. Columella white. Capillitium colourless or dark. Spores violet-

brown, spinulose, 8 to 11 μ diam. Name from diminutive of L. *squama* a scale.

Hab. On dead leaves; very common throughout the year.

9. **D. anel'lus** Morgan.—Sporangia grey, annular or irregular plasmodiocarps, depressed in the centre; crystals of lime on the wall scanty. Columella indefinite. Capillitium of slender flexuose violet-brown threads. Spores minutely spinulose, pale purple-brown, 7 to 8 μ diam. Name L. a little ring.

Hab. On dead leaves; autumn and winter.

10. **D. crusta'ceum** Fr.—Distinguished from *D. squamulosum* by the sporangia being often clustered and reniform on membranous stalks, by their being enclosed in a thick smooth fragile globose crust of loosely adhering large crystals, and by the more strongly spinulose spores, 10 to 13 μ diam. Name from L. *crusta* a crust.

Hab. On dead leaves, etc.; autumn and winter, not uncommon.

GENUS 11. **MUCILA'GO** Adanson.—Sporangia confluent, forming an æthalium enclosed in a mass of white lime-crystals; the other characters as in *Didymium*. Name Mod. L. mucilage, from the consistency of the young æthalium.

1. **M. spongio'sa** Morgan.—Plasmodium cream colour. Sporangia elongate and lobed. Columella hollow. Capillitium much branched. Spores dull purple, strongly spinulose, 10 to 13 μ diam. Name L. spongy.

Hab. On grass, dead leaves, etc., from summer to winter; frequent.

Var. **dictyos'pora** R. E. Fries.—This differs from the type in the very dark, closely reticulated spores. Name Gr. *diktuon* net, *spora* seed.

Hab. On straw; Bedfordshire.

Fig. 19.

MUCILAGO SPONGIOSA Morg.

a. Æthalium. Natural size.
b. Capillitium and fragment of sporangium-wall, with crystals of calcium carbonate and two spores. Magnified 200 times.

Fig. 20.

LEPIDODERMA TIGRINUM Rost.

a. Sporangium. Magnified 6 times.
b. Capillitium and spores. Magnified 140 times.

GENUS 12. **LEPIDODER'MA** de Bary.—Sporangium-wall cartilaginous, beset with superficial crystalline discs or scales. Capillitium usually rigid. Name Gr. *lepis* scale, *derma* skin.

1. **L. tigri'num** Rost.—Plasmodium orange-yellow. Sporangia subglobose, flattened beneath, dull olive; crystalline discs white. Stalk and hemispherical columella dull orange. Capillitium purple. Spores dark purplish grey, minutely spinulose, about 10 μ diam. Name L. tiger-like.

Hab. On bark and moss; autumn and winter.

2. **L. Carestia'num** Rost. forma **Chaillet'ii** Lister.—Sporangia subglobose, grey, sessile, rarely shortly stalked, or plasmodiocarps; sporangium-wall membranous, thickly covered with calcareous scales 10 to 40 μ diam., which may be in part absent. Columella buff, prominent, obtuse, or nearly wanting, filled with crystals of lime. Capillitium purple, rather slender, more or less marked with nodular thickenings; hypothallus dull orange, spongy, the surface thickly studded with calcareous scales. Spores purple-brown, 10 to 13 μ diam., minutely spinulose. Named after the Abbé A. Carestia, who found the type in Piedmont, 1868; and J. F. de Chaillet (1747 to 1837), who found the variety in Switzerland.

Hab. On dead leaves; winter, rare.

GENUS 13. **LEPTODER'MA** G. Lister.—Plasmodium drab. Sporangia with membranous walls, thickened towards the base with dark granular deposits, amongst which small calcareous scales are often embedded. Capillitium a network of blackish threads. Spores purplish grey. Name Gr. *leptos* thin, *derma* skin.

1. **L. irides'cens** G. Lister.—Sporangia scattered or clustered, sessile or on very short black stalks, subglobose, greyish purple, glossy, 0·5 to 0·8 mm. diam. Columella none. Capillitium a persistent network of slender blackish threads, which are often pale towards the base and may have expansions enclosing granular matter. Spores purplish grey, spinulose, 10 to 11 μ diam. Name from Gr. *iris* a rainbow, from the iridescence of the sporangium wall.

Fig. 21.
LEPTODERMA IRIDESCENS G. Lister.
a. Group of sporangia. Magnified 15 times.
b. Sporangium after dispersion of spores. Magnified 10 times.
c. Capillitium and spores. Magnified 140 times.

Hab. On dead leaves, twigs, etc.; autumn to spring, not common.

SUBCOHORT II.—*AMAUROCHÆTINEÆ.*

ORDER I.—COLLODERMACEÆ.

GENUS 14. **COLLODER'MA** G. Lister.—Sporangia sessile, with membranous walls enveloped in a gelatinous envelope. Capillitium a network of flaccid threads. Name Gr. *kolla* glue, *derma* skin.

1. **C. ocula'tum** G. Lister.—Sporangia scattered or in small clusters, sessile, rarely on short black stalks, subglobose, 0·3 to

Fig. 22.
COLLODERMA OCULATUM G. Lister.
a. Moist sporangium: the dark mass of spores shows through the translucent walls. Magnified 13 times.
b. Capillitium and spores. Magnified 140 times.

0·7 mm. diam., or forming plasmodiocarps, olive- or purplish brown, glossy; often the maturing sporangium emerges from its gelatinous envelope and shows iridescent membranous walls. Capillitium a network of flaccid purple-brown or colourless threads, always colourless at the extremities. Spores purplish grey, spinulose, 11 to 13 μ diam. Name from L. furnished with an eye, from the appearance of the sporangium when moist.

Hab. On dead wood, on mossy or lichened trunks of living trees, or on mossy peat, from summer to early spring, apparently not uncommon.

ORDER II.—STEMONITACEÆ.

GENUS 15. **STEMONI'TIS** Gleditsch. —Sporangia cylindrical, stalked, fasciculate, with evanescent walls; stalk continued as a columella to near the apex of the sporangium. Capillitium radiating from all parts of the columella, the ultimate branches normally uniting to form an even superficial net. Name Gr. *stemon* a stamen, from the shape of the sporangium.

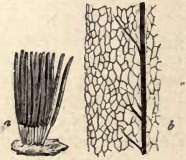

Fig. 23.
STEMONITIS SPLENDENS Rost.
a. Group of sporangia. Natural size.
b. Portion of capillitium and columella. Magnified 42 times.

1. **S. fus'ca** Roth.—Plasmodium white. Sporangia dark or reddish brown, 4 to 15 mm. high. Superficial net of the capillitium with angular meshes varying in size from 7 to 20 μ diam. Spores grey, or rufous-violet, closely reticulate and spinulose, 6 to 10 μ diam. Name L. dark brown.

Var. **flac'cida** Lister.—Sporangia weak. Capillitium scarcely forming a surface net. Name L. weak.

Var. **con'fluens** Lister.—Sporangia confluent, without superficial net or columellæ. Name L. clustered.

Hab. On dead wood. Common, especially in summer and autumn.

2. **S. splen'dens** Rost. — Plasmodium white. Sporangia rich purple-brown in mass, about 12 mm. long. Capillitium purple-brown; intermediate threads distant, nearly simple; surface net with smooth rounded meshes, 30 to 50 μ broad. Spores pale reddish purple, nearly smooth, minutely warted, 7 to 8 μ diam. Name L. beautiful.

Var. **Web'beri** Lister.—Mesh of surface net 80 to 100 μ broad. Named after H. J. Webber, of Manhattan, Kansas.

Var. **flac'cida** Lister.—Sporangia weak, adhering. Capillitium lax, scarcely forming a surface net; membranous flakes of sporangium-wall always present.

Hab. On dead wood, chiefly fir; the typical form and var. *Webberi* found hitherto in Cornwall and Ireland only, in the British Isles; var. *flaccida* common, especially in summer.

3. **S. con'fluens** Cooke & Ellis.—Sporangia confluent, without surface net or definite columellæ. Spores brownish purple, minutely warted, 8 to 11 μ diam.

Hab. On dead wood and leaves; not unfrequent, summer to winter.

4. **S. herbatica** Peck.—Plasmodium white. Sporangia brown, about 0·8 mm. long; mesh of surface net of the capillitium 10 to 20 μ broad. Spores pale reddish grey, nearly smooth, 6 to 8 μ diam. Name L. living on grass.

Var. **con'fluens** Lister.—Sporangia united to form an æthalium with persistent walls, and without stalks or columellæ.

Hab. On stumps and dead leaves; not unfrequent in summer and autumn. Distinguished from *S. splendens* by the smaller meshes of the surface net.

5. **S. flavogen'ita** Jahn.—Plasmodium yellow. Sporangia cinnamon-brown, 5 to 7 mm. high. Meshes of the capillitium net as in *S. fusca*, but the threads more slender. Spores pale ferruginous, nearly smooth, 8 to 9 μ diam. Name L. *flavus* yellow, *genitus* brought forth.

Hab. On dead wood; frequent in summer and autumn.

6. **S. ferrugin'ea** Ehrenb.—Plasmodium white. Distinguished from *S. flavogenita* by the longer sporangia and stalks, and minute spores, 4 to 6 μ diam. Name L. rusty.

Hab. On dead wood; not uncommon in summer and autumn.

7. **S. hyperop'ta** Meylan in Bull. Soc. Vaud. Sc. Nat. 52, no. 194, p. 97 (*Comatricha typhoides* Rost. var. *heterospora* Rex).—Plasmodium watery white. Sporangia in small clusters, warm lilac-brown, cylindrical, on short black stalks; total height 2 to 5 mm. Capillitium a dense network of flexuose brown threads, with a surface net complete only in the lower half of the sporangium. Spores 5 to 6 μ diam., marked with faint patches of close-meshed reticulation, pale lilac-brown. Name Gr. proud or overlooked.

Hab. On dead coniferous wood; summer and autumn, not uncommon.

GENUS 16. **COMAT'RICHA** Preuss.—Sporangia subglobose or cylindrical, stalked, gregarious. Capillitium as in *Stemonitis*, except that it is more dense, and the ultimate branches do not unite to form an even superficial net. Name Gr. *koma* head of hair, *thrix* wool.

Fig. 24.
COMATRICHA NIGRA Schroet.
a. Group of sporangia. Natural size.
b. Sporangium deprived of spores, showing the capillitium. Magnified 16 times.

1. **C. nig'ra** Schroet. — Plasmodium watery white. Sporangia globose, ellipsoid, or cylindrical, purple-brown. Total height, 1 to 6 mm. Stalks slender. Capillitium a dense tangle of purplish brown threads; ultimate branches curved and anastomosing. Spores brownish violet, nearly smooth, 7 to 11 μ diam. Name L. black.

Var. **al'ta** Lister.—Sporangia oblong or cylindrical. Capillitium a tangle of long flexuose threads attached to the base of the long columella. Name L. tall.

Hab. On dead wood; common throughout the year.

2. **C. lax'a** Rost. — Distinguished from *C. nigra* by the lax capillitium, and by the branches spreading from the columella in a more straight and radiating direction. Name L. loose.

Hab. On dead wood; fairly common from summer to winter.

3. **C. cor'nea** G. Lister & Cran.—Plasmodium watery white. Sporangia solitary, globose, dark brown, 0·12 to 0·32 mm. diam. Stalk subulate, 0·18 mm. high, dark above, brownish yellow below, with a dark collar round the base of the sporangium. Columella about one-third the height of the sporangium, dividing above into the few primary branches of the capillitium, which fork repeatedly and end at the surface in short rigid diverging branchlets. Spores 9 μ diam., minutely warted, grey when magnified. Name L. horny, from the antler-like character of the capillitium.

Hab. On bark and moss; rare or overlooked from its small size.

4. **C. fimbria'ta** G. Lister & Cran.—Sporangia scattered, globose, dark brown, 0·1 to 0·3 mm. diam. Stalks black, slender, subulate. Columella slender, reaching one-third the height of the sporangium. Capillitium arising from near the apex of the columella, consisting of purplish brown nearly simple threads, very slender at the base, clavate or forked at the tips. Spores 10 to 12 μ diam., greyish purple, paler on one side, minutely and closely spinulose. Name L. fringed, from the character of the capillitium.

Hab. On dead sticks; summer and autumn, rare.

5. **C. el'egans** Lister.—Sporangia globose, on slender stalks. Columella short, soon dividing into the few primary branches of the capillitium: these again branch repeatedly, and form towards the surface of the sporangium a loose tangle of slender flexuose anastomosing threads. Spores pale brownish violet, 8 to 10 μ diam.

On dead wood; summer and autumn. Very closely allied to *C. nigra*.

6. **C. lu'rida** Lister. — Plasmodium watery white. Sporangia globose, purple-brown, 0·5 mm. diam. Stalk setaceous, 0·75 mm. long. The purple-brown flexuose capillitium spreads from the upper half of the branching columella, which reaches to half the height of the sporangium. Spores subglobose, purplish grey, warted, 8 to 10 μ diam.

Hab. On dead leaves; autumn to spring, not common.

7. **C. typhoi'des** Rost.—Plasmodium watery white. Sporangia shortly cylindrical, lilac-brown after the disappearance of the silvery membranous wall, which is continued over the black stalk; total height 2 to 3 mm. Columella reaching to near the apex of the sporangium. Capillitium a close network of pale brown flexuose threads with many free ends. Spores pale violet-brown, almost smooth, with 3 or 4 prominent warts on the hemisphere, 6 to 7 μ diam. Name from L. *typha* reed-mace.

Hab. On rotten wood; abundant, especially in summer.

8. **C. micros'pora** G. Lister (syn. *C. typhoides* var. *microspora* Lister).—Plasmodium watery white. Sporangia loosely clustered or scattered, lilac-brown, cylindrical, shortly stalked; total height 3 mm. Capillitium dense; surface net close, continuous, of wavy looped threads. Spores nearly smooth, 3·5 to 4·5 μ diam. Name Gr. *mikros* small, *spora* spore.

Hab. On dead leaves and wood; autumn, not common.

9. **C. pulchel'la** Rost.—Plasmodium watery white. Sporangia cylindrical or clavate, rufous-brown, including the short stalk about 1 mm. high; columella nearly reaching the apex. Capillitium dense, of flexuose brown threads, the ultimate branches curved and anastomosing, with few free ends. Spores pale lilac-brown, minutely warted, 6 to 8 μ diam. Name L. pretty.

Var. **fus'ca** Lister.—Closely allied to the type, but with darker spores. Name L. dusky.

Hab. On dead leaves; frequent in autumn.

10. **C. tener'rima** G. Lister (syn. *C. pulchella* var. *tenerrima* Lister).—Plasmodium watery white. Sporangia scattered, ovoid or narrowly cylindrical, pale red or lilac-brown, equalling or shorter than the slender black stalks; total height 1·5 to 2 mm.; columella cylindrical, long. Capillitium a tangle of slender flexuose pale red threads. Spores pale flesh-colour, minutely warted, 7 to 8 μ diam. Name L. most delicate.

Hab. On dead herbaceous stems and dead wood; summer to winter.

11. **C. ru'bens** Lister.—Plasmodium watery white. Sporangia subglobose or pyriform, pinkish brown, including the stalk about 1·5 mm. high. Columella branched above, and reaching two-thirds the height of the sporangium. Capillitium brownish violet, branching from all parts of the columella, with slender free ends. The lower

branches have broad attachments to the lower part of the sporangium-wall, which forms a persistent cup. Spores as in *C. pulchella*. Name L. red.

Hab. On dead leaves; not rare in autumn and winter.

GENUS 17. **ENERTHENE'MA** Bowman.—Sporangia stalked. Columella reaching to the summit of the sporangium. Capillitium springing from beneath the superficially extended apex of the columella. Name Gr. *enerthe* beneath, *nema* a thread.

1. **E. papilla'tum** Rost.—Plasmodium colourless. Sporangia globose, black. Capillitium-threads long, sparingly branched. Spores greyish brown, spinulose, 8 to 10 μ diam. Name from L. *papilla* nipple.

Hab. On dead wood; frequent, especially in autumn and winter.

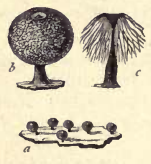

Fig. 25.

ENERTHENEMA PAPILLATUM Rost.

a. Group of sporangia. Twice the natural size.
b. Sporangium. Magnified 16 times.
c. Sporangium deprived of spores, showing the capillitium. Magnified 16 times.

Fig. 26.

LAMPRODERMA SCINTILLANS Morg.

a. Group of sporangia. Magnified 2½ times.
b. Sporangium deprived of spores, showing capillitium. Magnified 25 times.

GENUS 18. **LAMPRODER'MA** Rostafinski.—Sporangia globose or ellipsoid, usually stalked, stalk black; sporangium-wall somewhat persistent, shining with iridescent colours. Capillitium of branching and anastomosing threads radiating from the upper part of the columella. Name Gr. *lampros* bright, *derma* skin.

1. **L. columbi'num** Rost.—Plasmodium colourless. Sporangium ellipsoid or globose, 0·5 to 0·8 mm. diam. Stalk 1 to 2 mm. long. Columella more than half the height of the sporangium. Capillitium of purple-brown threads, straight and sparingly anastomosing below, much branched and slender towards the surface. Spores purple-grey, closely spinulose, 11 to 14 μ diam. Name L. dove-coloured, from the sporangia having the iridescence of a pigeon's neck.

Hab. On fir-wood and moss; autumn and winter, not unfrequent.

2. **L. echinula'tum** Rost.—Total height 2 to 2·5 mm. Sporangia globose, 0·7 mm. diam. Columella cylindrical, obtuse, half the height of the sporangium. Capillitium lax, springing from the

upper part of the columella, of nearly straight forking black strong threads with pale tips. Spores dark grey, echinulate with black spines, 15 to 20 μ diam. Name from L. *echinus* sea-urchin.

Hab. On dead wood; autumn, uncommon.

3. **L. arcyrione'ma** Rost.—Plasmodium colourless. Total height 1 to 1·5 mm. Sporangia globose, shining, 0·5 mm. diam. Columella half the height of the sporangium, slender, smooth to the apex, where it divides into the primary branches of the dense black crisped capillitium. Spores lilac-grey, smooth, 6 to 7 μ diam. Name from the genus *Arcyria*, and Gr. *nema* thread.

Hab. On dead wood; summer and autumn, not common.

4. **L. scin'tillans** Morg.—Plasmodium colourless. Total height 1 to 1·5 mm. Sporangia globose, iridescent blue, red or bronze, on setaceous stalks. Columella cylindrical, half the height of the sporangium. Capillitium of rigid, dichotomously branched, blackish threads, colourless at the base, where they are attached to the truncate apex of the columella. Spores 6·5 to 8 μ diam., marked with minute, not crowded warts. Name L. sparkling.

Hab. On dead leaves; common from summer to early spring.

5. **L. viola'ceum** Rost.—Plasmodium colourless. Total height, 0·6 to 1·5 mm. Sporangia subglobose, iridescent blue, 0·4 to 0·9 mm. diam.; on setaceous or thicker stalks. Columella one-third to two-thirds the height of the sporangium. Capillitium pale and flaccid, or brown and dense. Spores purplish grey, closely spinulose, 8 to 11 μ diam. Name L. violet.

Var. **de'bile** G. Lister & Howard (Journ. Bot. lvii. p. 25, Pl. 552, fig. 1).—Sporangia sessile on a membranous base, with columella short or absent. Spores purplish grey, minutely spinulose, 10 to 11 μ diam. Name L. weak.

Var. **Sau'teri** Lister.—A robust subalpine form, with pale brown or brown wavy capillitium threads, and darker often more spinose spores, 11 to 15 μ diam. Named after Dr. Sauter, who found this form near Salzburg, 1863.

Var. **Cares'tiæ** Lister.—Also a subalpine form; it has dense, very dark, usually frizzled capillitium, and purple-brown spinulose or spinose spores, 10 to 15 μ diam. Named after Abbé A. Carestia, who gathered this form in Piedmont in 1861.

Hab. On sticks and dead leaves.

6. **L. atros'porum** Meylan var. **an'glicum** G. Lister & Howard (Journ. Bot. lvii. p. 27, Pl. 552, fig. 2).—Sporangia clustered or scattered, obovoid or subglobose, iridescent or glossy blue-black, sessile or on short slender stalks. Columella cylindrical. Capillitium of dark, flexuose, anastomosing threads attached by the tips to the sporangium-wall. Spores 11 to 13 μ, purplish grey, closely reticulated. Name L. *ater* black, Gr. *spora* spore.

Hab. On dead leaves; spring, rare.

7. **L. inses'sum** G. Lister (Trans. Brit. Myc. Soc. iv. p. 41, Pl. 1, figs. 2, 2a, 2b, 1912).—Sporangia clustered, subglobose, iridescent purple, sessile, 0·8 mm. diam. Columella none. Capillitium a scanty network of broad purplish threads. Spores brownish purple, closely marked with sharp spinules, 18 to 19 μ diam. Name L. perched.

Hab. On lichen on living trees; rare.

GENUS 19. **CLASTODER'MA** Blytt.—Sporangia globose, stalked; capillitium threads forked repeatedly, and attached at the tips to small membranous discs. Name Gr. *klastos* broken in pieces, *derma* skin, from the sporangium-wall persisting in the form of minute discs.

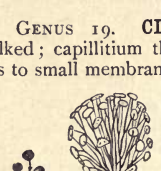

Fig. 27.
CLASTODERMA DEBARYANUM Blytt.
a. Group of sporangia. Magnified 10 times.
b. Sporangium showing capillitium. Magnified 64 times.

1. **C. Debarya'num** Blytt.—Plasmodium watery white. Sporangia minute, stalked, brown, 0·15 to 0·2 mm. diam. Stalk subulate, 0·5 to 1 mm. long, dark and rugged below, slender, pale and translucent above. Columella very short, dividing into the few primary branches of the capillitium, which fork once or twice; the tips of the branchlets adhere at the surface to small membranous discs. Spores brown in mass, smooth, 7 to 10 μ diam. Named after Anton de Bary, 1831 to 1888, of Belgian family; a great botanist; a master in the study of Mycetozoa.

Hab. On dead wood; rare.

GENUS 20. **ECHINOSTE'LIUM** de Bary.—Sporangia stalked, minute, colourless. Capillitium branches few, arising from the apex of the short columella. Name Gr. *ekhinos* hedgehog, *stele* column.

1. **E. minu'tum** de Bary.—Sporangia colourless, globose, 50 μ diam. Columella very short. Capillitium of two or three colourless zigzag threads, sparingly branched and anastomosing, and with free spine-like branchlets. Stalk setaceous, attenuated upwards, 0·5 mm. long, consisting of a hyaline membrane enclosing nearly colourless refuse matter. Spores colourless, smooth, 6 μ diam. Name L. minute.

Hab. On dead wood. Resembling a species of *Mucor*, and apparently most nearly allied to *Clastoderma Debaryanum* Blytt.

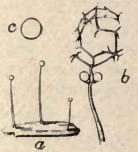

Fig. 28.
ECHINOSTELIUM MINUTUM de Bary.
a. Group of three sporangia. Magnified 20 times.
b. Sporangium showing capillitium; all the spores dispersed but two. Magnified 280 times.
c. Spore. Magnified 500 times.

ORDER III.—AMAUROCHÆTACEÆ.

GENUS 21. **AMAUROCHÆ'TE** Rostafinski.—Æthalia pulvinate, composed of elongate confluent sporangia. Sporangium-walls not developed. Capillitium rising from the base in irregularly flattened strands, and dividing into many anastomosing branches. Name Gr. *amauros* dark, *khaite* hair.

Fig. 29.
AMAUROCHÆTE FULIGINOSA Macbr.
a. Æthalium. Half natural size.
b. Capillitium. Magnified 10 times.

1. **A. fuligino'sa** Macbr.—Plasmodium white. Æthalium 4 cm. or more diam., black, covered with a silvery evanescent cortex. Capillitium as described in the genus. Spores dull purple, spinulose, paler on one side, 11 to 13 μ diam. Name L. sooty.

Hab. On fir-wood; not uncommon.

2. **A. cribro'sa** Sturgis, in Mycologia, ix. p. 329, 1917.—Æthalia hemispherical or pulvinate, glossy black, 1 to 4 cm. diam. Columellæ numerous, irregular. Capillitium a network of dark arcuate threads. Spores as in *A. fuliginosa*. Name from L. *cribrum* a sieve.

Hab. On dead wood; rare.

GENUS 22. **BREFEL'DIA** Rostafinski.—Æthalia pulvinate, composed of subcylindrical, branched, and confluent sporangia. Capillitium of numerous horizontal threads, those of adjacent sporangia uniting on the boundary line and there forming chambered vesicles. Named after O. Brefeld, a German botanist.

Fig. 30.
BREFELDIA MAXIMA Rost.
a. Æthalium. Natural size.
b. Capillitium and spores. Magnified 50 times.

1. **B. max'ima** Rost.—Plasmodium white. Æthalia sometimes many inches across, 5 to 10 mm. thick, purplish brown. Capillitium brown. Spores purplish brown, minutely spinulose, 9 to 12 μ diam. Name L. largest.

Hab. On dead wood; not uncommon in autumn and winter.

COHORT II.—*LAMPROSPORALES.*

SUBCOHORT I.—*ANEMINEÆ.*

ORDER I.—HETERODERMACEÆ.

GENUS 23. **LINDBLAD'IA** Fries.—Sporangia either combined to form an æthalium or closely compacted on a strongly developed hypothallus. Named after M. A. Lindblad (1821 to 1899), a Swedish botanist.

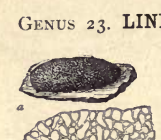

Fig. 31.
LINDBLADIA EFFUSA Rost.
a. Æthalium. Natural size.
b. Vertical section of æthalium. Magnified 6 times.

1. **L. effu'sa** Rost.—Æthalia thin or pulvinate, consisting of confluent sporangia about 0·4 mm. diam., with persistent membranous walls; either black and rugose, with a cortex formed of imperfectly developed spores, or umber-brown with a surface of complete sporangia. Spores ochraceous-brown, nearly smooth, 4 to 6 μ diam. Name L. poured out.

Hab. On dead coniferous wood; not common.

GENUS 24. **CRIBRA'RIA** Persoon.—Sporangia globose, stalked; sporangium-wall persistent and usually forming a cup in the lower half, continued above as a net of slender threads more or less thickened at the nodes, evanescent in the meshes. Spores nearly smooth. Name from L. *cribrum* a sieve, from the openings in the sporangium-wall.

Fig. 32.
CRIBRARIA VULGARIS Schrad.
a. Group of sporangia. Twice natural size.
b. Sporangium after dispersion of the spores. Magnified 20 times.

1. **C. argilla'cea** Pers.—Plasmodium purple-brown or lead colour. Sporangia shortly stalked, sometimes sessile, crowded, clay-coloured, about 1 mm. diam.; sporangium-wall subpersistent throughout, cup imperfectly defined; net usually continued to the base, nodes scarcely thickened. Spores ochraceous, 5 μ diam. Name L. clayey.

Hab. On dead wood; common in summer and autumn.

2. **C. ru'fa** Rost.—Plasmodium milk-white. Sporangium orange-red, about 0·6 mm. diam., with a cup one-third its height distantly toothed on the margin; net wide-meshed, threads firm, nodes scarcely thickened. Stalk as long as the sporangium, black. Spores pale yellowish red, 6 μ diam. Name L. red.

Hab. On dead fir-wood; not uncommon in autumn.

3. **C. macrocar'pa** Schrad.—Plasmodium slate-coloured. Sporangia robust, 0·6 to 0·8 mm. diam., nut-brown; the cup marked with numerous longitudinal ribs and perforated towards the deeply

toothed margin, which merges into an irregular net with branching nodes. Spores ochraceous, 5 μ diam. Name Gr. *makros* large, *spora* spore.

Hab. On dead fir-wood; not common.

4. **C. vulgaris** Schrad. — Plasmodium usually lead colour. Sporangium nut-brown, about 0·5 mm. diam., with a cup one-third its height, deeply toothed on the margin; net with slender threads and flat angular branching nodes. Stalk twice to four times the length of the sporangium, dark brown. Spores ochraceous, 5 μ diam. Name L. common.

Var. **auranti'aca** Pers.—Plasmodium green. Nodes of the net usually dark brown, convex. Spores yellow. Name Mod. L. orange-coloured.

Hab. On dead wood, chiefly fir; common in summer.

5. **C. intric'ata** Schrad.—Sporangium ochraceous-brown, 0·5 to 0·7 mm. diam., with a cup one-third its height, or wanting; the net close, delicate, regular; nodes numerous, small, polygonal, often branched, dark brown, with many free rays. Stalk long, subulate. Spores ochraceous, 5 μ diam. Name L. complex.

Hab. On dead coniferous wood; not common; summer.

6. **C. tenel'la** Schrad.—Plasmodium brownish black. Differs from *C. intricata* in the nodes of the net being rounded and without free rays. Name L. delicate.

Hab. On dead coniferous wood; not common.

7. **C. pyrifor'mis** Schrad.—Sporangium globose or turbinate, brittle, 0·5 mm. diam., purplish brown, with a cup one-third its height; net with brownish yellow firm threads, and dark somewhat triangular nodes; these and the yellowish sporangium-wall are densely studded with large purple-brown plasmodic granules, 2 μ diam. Stalk dark purple-brown. Spores pinkish ochre, 5 μ diam. Name L. *pyrus* pear, *forma* shape.

Var. **notab'ilis** Rex.—Sporangia globose; net with many prominent rounded nodes connected by slender threads; plasmodic granules smaller. Name L. remarkable.

Hab. On dead coniferous wood and sawdust; summer and autumn.

8. **C. viola'cea** Rex.—Sporangium minute, about 0·2 mm. diam., dark violet, on a long stalk; the membranous cup violet-blue, one- to two-thirds the height of the sporangium; net of delicate threads connecting the broad, flat, angular nodes. Spores lilac, minutely warted, 7 μ diam. Name L. violet.

Hab. On dead wood of beech, ash, etc.; not common.

GENUS 25. **DICTYD'IUM** Schrad.—Sporangium-wall with parallel ribs extending from the base to the apex, connected by slender transverse threads. Name Gr. little net.

Fig. 33.
DICTYDIUM CANCELLATUM Macbr.
a. Group of sporangia. Twice natural size.
b. Sporangium after dispersion of the spores. Magnified 20 times.

1. **D. cancella'tum** Macbr. — Plasmodium purple. Sporangia globose, becoming umbilicate above, 0·5 to 0·7 mm. diam., nodding, red-purple; the ribs arising from the slender apex of the stalk. Spores pale red-brown, 4 to 7 μ diam., with two or three purple plasmodic granules on the hemisphere. Name L. latticed.

Var. **fuscum** Lister differs from the type in being browner in colour, and having a definite cup from the margin of which the ribs arise. Name L. dark brown.

Hab. On dead wood; frequent in summer.

ORDER II.—LICEACEÆ.

GENUS 26. **LICE'A** Schrad.—Sporangia sessile. Sporangium-wall cartilaginous. Capillitium wanting. Name; derivation unknown.

1. **L. flexuo'sa** Pers.—Plasmodium dull yellow or rosy. Plasmodiocarps elongate, often branching, dark brown. Spores pale olive-brown, spinulose, 11 to 14 μ diam. Name L. curved.

Hab. On dead coniferous wood; frequent.

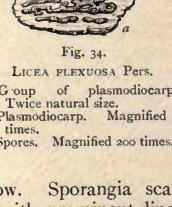

Fig. 34.
LICEA FLEXUOSA Pers.
a. Group of plasmodiocarps. Twice natural size.
b. Plasmodiocarp. Magnified 6 times.
c. Spores. Magnified 200 times.

2. **L. pusil'la** Schrad.—Plasmodium pale drab. Sporangia hemispherical or pulvinate, 0·5 to 1 mm. diam., dark brown, glossy, dehiscing by lobes. Spores olive-brown, smooth, 16 to 20 μ diam. Name L. small.

Hab. On dead coniferous wood; not common.

3. **L. min'ima** Fries.— Plasmodium yellow. Sporangia scattered, hemispherical, chestnut or dark brown, with prominent lines of dehiscence, 0·2 to 0·5 mm. diam. Spores spinulose, olive or lilac-brown, paler on one side, 9 to 12 μ diam. Name L. least.

Hab. On dead coniferous wood; summer and autumn.

4. **L. casta'nea** G. Lister.—Sporangia minute, pale brown or chestnut, subglobose or forming plasmodiocarps, 0·2 mm. broad, angular with prominent lines of dehiscence. Spores olive-yellow in mass, nearly colourless when magnified, smooth, 8 to 10 μ diam. Name L. chestnut.

Hab. On mossy bark of living and dead trees; Scotland.

GENUS 27. **HYMENOB'OLUS** Zukal.—Sporangia very minute, scattered, sessile, opening with a membranous lid. Name Gr. *humen* membrane, *bolos* lump.

1. **H. parasit'icus** Zukal.—Plasmodium rosy, contracted, not spreading in veins. Sporangia scattered, subglobose, hemispherical or irregular, 0·05 to 0·2 mm. diam., drab, or blackish with deposits of refuse matter, dehiscing usually with a glossy membranous lid. Capillitium none. Spores 13 to 15 μ diam., pale brown with rosy contents, the wall thinner on one side. Name Gr. parasitic.

Hab. Parasitic on living lichens and algæ on tree-trunks.

Fig. 35.
HYMENOBOLUS PARASITICUS Zukal.
a. Group of sporangia. Magnified 40 times.
b. Two spores; fragment of membranous lid, and of lower sporangium-walls thickened with refuse matter. Magnified 270 times.

Fig. 36.
ORCADELLA OPERCULATA Wing.
a. Group of sporangia. Magnified 8 times.
b. Sporangium with open lid. Magnified 40 times.

GENUS 28. **ORCADEL'LA** Wingate.—Sporangia stalked, subglobose, opening with a lid. Name diminutive of L. *orca* jar.

1. **O. opercula'ta** Wing.—Plasmodium dull orange. Sporangia scattered, stalked, urn-shaped or subglobose, dark brown, opaque, 0·2 to 0·3 mm. diam., with a flat or dome-shaped yellowish lid, stalk black, furrowed. Spores in mass pink or yellowish; smooth, 8 to 11 μ diam. Name L. with a lid.

Hab. On bark of living and dead trees.

ORDER III.—TUBULINACEÆ.

GENUS 29. **TUBIF'ERA** Gmelin.—Sporangia tubular, compacted. Capillitium wanting. Name L. *tubus* tube, *fero* I bear.

1. **T. ferrugino'sa** Gmel.—Plasmodium rose or cream-coloured. Sporangia cylindrical, crowded on a spongy hypothallus, forming a rounded honeycomb-like rufous-brown mass. Spores pale rufous-brown, reticulate, 5 to 8 μ diam. Name L. rust-coloured.

Hab. On dead wood; frequent in autumn.

Fig. 37.
TUBIFERA FERRUGINOSA Gmel.
Cluster of sporangia. Magnified 2½ times.

ORDER IV.—RETICULARIACEÆ.

GENUS 30. **DICTYDIÆTHA'LIUM** Rostafinski.—Æthalium flat, formed of erect columnar sporangia. Sporangium-wall incomplete, dome-shaped on the top, continued to the base in four to six straight threads. Name Gr. *diktudion* a little net, *æthalium* the term for a compound fructification.

1. **D. plum'beum** Rost.—Plasmodium rose-coloured. Æthalium dull slate or clay-coloured, minutely areolated with the convex apices of the sporangia, which are 0·2 mm. diam. Spores pale yellow, spinulose, 9 to 12 μ diam. Name L. lead-coloured.

Hab. On dead wood; frequent in autumn and winter.

Fig. 38.

DICTYDIÆTHALIUM PLUMBEUM Rost.

a. Æthalium. Natural size.
b. Eight sporangia of an æthalium isolated; in three the column of spores has fallen away, leaving the cap and persistent threads. Magnified 20 times.

Fig. 39.

ENTERIDIUM OLIVACEUM Ehrenb.

a. Plasmodiocarp. Magnified twice.
b. Part of spurious capillitium. Magnified 35 times.
c. A spore cluster, and one isolated spore. Magnified 210 times.

GENUS 31. **ENTERID'IUM** Ehrenberg.—Æthalium composed of confluent interwoven sporangia, their internal walls perforated with large openings or forming columnar props. Name diminution from Gr. *enteron* intestine.

1. **E. oliva'ceum** Ehrenb.—Plasmodium rose-colour. Æthalium pulvinate, olive-brown, 1 to 3 cm. diam., but very variable in size; sporangium-walls yellow-olive. Spores in clusters of 6 to 20, sometimes free, pale olive, warted on one side, 9 to 12 μ diam. Name L. olive.

Hab. On dead wood; autumn and winter.

2. **E. liceoi'des** G. Lister (*E. olivaceum* var. *liceoides* Lister).—Plasmodium rosy. Sporangia forming plasmodiocarps, simple or combined into a flat net, glossy brown or purple-brown, the internal walls represented usually by columnar strands or tubes. Spores pale brown, spinulose, clustered, 10 to 12 μ diam. Name Mod. L. like *Licea*.

Hab. On dead coniferous wood; autumn.

GENUS 32. **RETICULA'RIA** Bulliard. —Æthalia composed of interwoven sporangia; the persistent portion of their walls rusty brown, forming broad membranous folds and strands, dividing above into threads. Name L. *reticulum* a little net.

1. **R. Lycoper'don** Bull.—Plasmodium cream-white. Æthalium pulvinate, 2 to 8 cm. diam., usually enveloped in a silvery cortex. Spores pale rusty-brown, closely reticulate on one side, 6 to 8 μ diam. Name a genus of Puff-balls.

Hab. On stumps; common from early summer to early autumn.

Fig. 40.
RETICULARIA LYCOPERDON Bull.
a. Æthalium. Natural size.
b. Fragment of capillitium. Magnified 100 times.

GENUS 33. **LICEOP'SIS** Torrend. — Sporangia subglobose, sessile, closely compacted, with fragile membranous walls. Capillitium when present consisting of slender branching threads and strands with membranous expansions at the axils. Name from *Licea* and Gr. *opsis* appearance.

Fig. 41.
LICEOPSIS LOBATA Torrend.
a. Two groups of sporangia. Magnified 3½ times.
b. Capillitium. Magnified 50 times.
c. Spore. Magnified 450 times.

1. **L. loba'ta** Torrend. — Plasmodium watery white. Sporangia subglobose, often depressed, angled by mutual pressure, rarely solitary, rusty brown, shining iridescent, about 0·5 mm. diam. Spores rusty brown, reticulate, 6 to 10 μ diam. Name Mod. L. lobed.

Hab. On old stumps; summer, not common.

ORDER V.—LYCOGALACEÆ.

Sporangia forming an æthalium; spurious capillitium consisting of smooth or wrinkled branching tubes.

GENUS 34. **LYCOG'ALA** Adanson.—Æthalia subglobose, with a cortex consisting of two or more closely combined layers, and provided with cell-like vesicles. Capillitium-tubes thick-walled where they traverse the cortex; thin-walled amongst the spores. Spores in mass pale pinkish grey or grey. Name Gr. *lukos* wolf, *gala* milk.

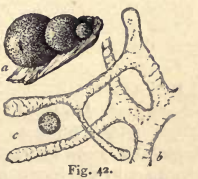

Fig. 42.
LYCOGALA EPIDENDRUM Fries.
a. Three æthalia. Natural size.
b. Capillitium. Magnified 150 times.
c. Spore. Magnified 600 times.

1. **L. flavofus'cum** Rost. — Plasmodium white. Æthalia subpyriform, 2 to 5

cm. diam., pale drab, smooth, minutely areolate and mottled; the cortex thick, of three layers, the middle one consisting of an aggregation of yellow vesicles. Capillitium branched and anastomosing. Spores minutely reticulate, 5 to 6 μ diam., dirty white in mass. Name L. *flavus* yellow, *fuscus* dusky.

Hab. On dead wood; not frequent.

2. **L. epiden'drum** Fries.—Plasmodium coral-red, rarely yellow. Æthalia sub-globose, from 2 mm. to 1 cm. diam., crowded or scattered, at first rose-red, maturing to pale yellowish brown, minutely warted; cortex with the vesicles arranged on the surface. Spores minutely reticulate, 5 to 7 μ diam., greyish pink in mass. Name Gr. *epi* upon, *dendron* tree.

Hab. On dead wood; common in summer and autumn.

SUBCOHORT II.—*CALONEMINEÆ.*

ORDER I.—TRICHIACEÆ.

GENUS 35. **TRIC'HIA** Haller.—Sporangia stalked or sessile; elaters free, pointed at each end, thickened with two to five spiral bands. Name Gr. *thrix* a hair.

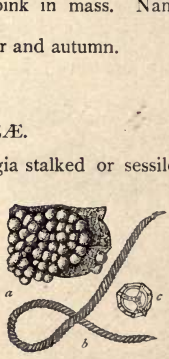

Fig. 43.
TRICHIA AFFINIS de Bary.
a. Group of sporangia. Twice natural size.
b. Elater. Magnified 250 times.
c. Spore. Magnified 400 times.

** Spores reticulate*

1. **T. favogin'ea** Pers.—Plasmodium white. Sporangia yellow, 0·6 to 0·7 mm. broad, ovoid, erect, crowded, sessile. Elaters 7 μ diam., with 5 spiral bands. Spores yellow, 13 to 15 μ diam., widely reticulate with deep narrow bands, giving a border about 2 μ wide. Name from L. *favus* honeycomb.

Hab. On fir-stumps; not common.

2. **T. verruco'sa** Berk.—Plasmodium white. Sporangia yellow, pyriform, stalked, 0·8 mm. broad, clustered. Stalks 0·2 to 0·7 mm. long, often combined, membranous, yellow-brown. Elaters 5 μ diam., with 3 to 5 spiral bands. Spores 13 to 15 μ diam., reticulate with shallow narrow bands forming a network with about seven meshes to the hemisphere; border 1 μ wide. Name L. warty, from the rough spores.

Hab. On dead wood; not common; autumn.

3. **T. affi'nis** de Bary.—Plasmodium white. Sporangia yellow, globose, crowded, sessile, 0·6 to 1 mm. diam. Elaters 5 μ diam., with 4 to 5 spiral bands. Spores 13 to 15 μ diam., reticulated with shallow pitted bands forming a network with three or four meshes to the hemisphere, border 1 μ wide. Name L. akin.

Hab. On stumps; common throughout the year.

4. **T. persimʹilis** Karst.—Plasmodium white. Sporangia yellow-brown, globose, crowded, sessile, 0·5 to 0·8 mm. diam. Elaters 4·5 μ diam., with 4 to 5 spiral bands, spinulose. Spores yellow-brown, 11 to 14 μ diam., with the reticulation broken into irregular shallow pitted warts; border interrupted. Name L. very like.

Hab. On stumps; common throughout the year.

5. **T. scabʹra** Rost.—Plasmodium white. Sporangia orange-yellow or olivaceous, globose, crowded, sessile, 0·8 mm. diam. Elaters orange, 5 μ diam., with 4 to 5 spiral bands which are often spinose, and rather irregular. Spores orange, 10 μ diam., closely reticulate, without a border. Name L. rough, from the spinose elaters.

Hab. On stumps; common from summer to winter.

*** Spores minutely warted or spinulose.*

6. **T. varʹia** Pers.—Plasmodium white. Sporangia ochraceous, globose or turbinate, 0·8 mm. diam., crowded or scattered, sessile or on short dark stalks. Elaters 4 μ diam., with two spiral bands. Spores ochraceous, minutely warted, 13 μ diam. Name L. variable.

Hab. On dead wood; common, especially in autumn and winter.

7. **T. contorʹta** Rost.—Plasmodium watery white. Sporangia yellow-brown or red-brown, subglobose or plasmodiocarps, about 0·6 mm. diam., crowded or scattered, sessile; sporangium-wall charged with brown granular matter. Elaters yellow or brown, 3 (rarely 5) μ diam., with four close, sometimes indistinct, spiral bands; the tips often swollen and ending in a curved point. Spores yellow, minutely warted, 12 μ diam. Name L. twisted, from the curved sporangia.

Hab. On dead wood; frequent in autumn and winter.

8. **T. lutesʹcens** Lister.—Sporangia globose, 0·2 to 0·7 mm. diam., sessile, bright yellow or olive-yellow; sporangium-wall membranous, free from granular matter; elaters long, sometimes forked or very short, 3 to 4 μ diam., smooth with 3 to 4 faint spiral bands, the tips rounded or shortly tapering, spores yellow or with an olive tint, minutely warted, 10 to 12 μ diam. Name L. yellowish.

Hab. On dead wood; autumn and winter, not common.

9. **T. decipʹiens** Macbr.—Plasmodium rose-coloured or white. Sporangia turbinate, stalked, gregarious, shining olive, 0·8 mm. diam. Sporangium-wall translucent. Stalk hollow, filled to the base with spores. Elaters brown, tapering into long slender points; spiral bands 4 to 5. Spores yellow-brown, minutely warted, 9 to 12 μ diam. Name L. deceiving.

Hab. On dead wood; common throughout the year.

10. **T. Botry'tis** Pers.—Plasmodium purple-brown. Sporangia turbinate, stalked, gregarious, simple or combined in clusters, purplish or rosy brown, often reticulate with yellow veins, or black. Stalk dark brown, solid. Elaters brown, tapering into long slender points; spiral bands 3 to 5, prominent on the margin. Spores ochraceous, minutely spinulose, 9 to 11 μ diam. Name Gr. *Botrus* a bunch of grapes.

Hab. On dead wood; common, especially in autumn and winter.

Var. **flavico'ma** Lister.—Sporangia minute, solitary; elaters and spores bright yellow. Name L. yellow-haired.

Hab. On dead leaves of holly, etc.; autumn and winter.

Var. **mun'da** Lister.—Elaters smooth, reddish yellow, with neat regular spiral bands. Name L. neat.

Hab. On dead leaves, twigs and wood; autumn and winter.

Var. **cerifera** G. Lister (Journ. Bot. liii. p. 211, 1915).—Sporangia red-brown, spotted with patches of yellow wax.

11. **T. florifor'mis** G. Lister (Journ. Bot. lvii. p. 110, 1919, syn. *T. Botrytis*, var. *lateritia* Lister). — Sporangia purple-red or nearly black, clustered on red translucent stalks. Elaters pale burnt-sienna, with shortly tapering points. Spores orange, 10 μ diam. Name L. *flos* flower, *forma* shape.

Hab. On dead wood; summer to winter; not common.

GENUS 36. **OLIGONE'MA** Rostafinski. — Sporangia minute, densely clustered, sessile. Elaters more or less scanty, spiral bands obscure. Name Gr. *oligos* few, *nema* thread.

Fig. 44.

OLIGONEMA NITENS Rost.

a. Cluster of sporangia. Magnified 3 times.
b. Elater. Magnified 280 times.
c. Spore. Magnified 400 times.

1. **O. ni'tens** Rost. — Plasmodium watery white. Sporangia subglobose, 0·3 mm. diam., heaped together, shining, yellow. Elaters usually few, short, obtuse, sometimes longer and pointed; spiral markings faint or wanting. Spores 11 to 16 μ diam., yellow, reticulate, with a border 1 μ wide. Name L. shining.

Hab. On dead wood, especially on half submerged logs; summer and autumn.

2. **O. fla'vidum** Peck.—Sporangia ovoid, erect, 0·5 to 0·6 mm. diam., crowded or somewhat heaped. Elaters fairly abundant, long, or sometimes short, without distinct spiral bands, but marked with close irregular lines of minute warts. Spores 12 to 13 μ diam., regularly reticulate with narrow bands. Name L. golden-yellow.

Hab. As in *O. nitens*.

GENUS 37. **HEMITRIC'HIA** Rostafinski.—Sporangia stalked or sessile; capillitium an elastic network of branching threads thickened with spiral bands. Name Gr. *hemi* half, and *Trichia*.

1. **H. vespa'rium** Macbr.—Plasmodium purple-red. Sporangia subcylindrical, glossy purple-red or nearly black, about 0·6 mm. broad, in clusters of 6 to 12, with wrinkled membranous red-brown stalks not containing spores. Capillitium-threads orange-red, with 3 to 5 regular spiral bands, strongly spinose. Spores orange-red, minutely warted, 10 μ diam. Name L. wasps' nest.

Hab. On dead wood; not uncommon throughout the year.

Fig. 45.
HEMITRICHIA VESPARIUM Macbr.
a. Cluster of sporangia. Magnified 2½ times.
b. Capillitium. Magnified 280 times.
c. Spore. Magnified 400 times.

2. **H. intor'ta** Lister.—Sporangia turbinate, 0·5 mm. broad, scattered, bright yellow, on short, dark, solid stalks. Capillitium-threads orange-yellow, twisted, spinulose, with 4 or 5 close, more or less distinct, spiral bands. Spores orange, minutely warted, 10 μ diam. Name L. twisted, from the twisted capillitium.

Hab. On dead wood; autumn and winter, not common.

3. **H. leiot'richa** Lister.—Plasmodium watery-white. Sporangia scattered, turbinate, shining olive-yellow, on stout black stalks. Capillitium a tangle of sparingly branched smooth yellow threads with few or many shortly pointed free ends, and marked with 3 to 6 often faint spiral bands. Spores yellow or olivaceous, minutely warted, 9 to 13 μ. Name Gr. *leios* smooth, *thrix* thread.

Hab. On dead leaves, bramble stems, etc.; autumn to spring.

4. **H. clava'ta** Rost.—Plasmodium white or rosy. Sporangia turbinate, 0·7 mm. broad, stalked, shining, ochraceous-yellow. Stalk cylindrical, dark, hollow, filled with spores. Capillitium-threads yellowish olive, with 5 or 6 well-defined bands arranged in a lax spiral. Spores ochraceous, minutely warted, 8 to 10 μ diam. Name from L. *clava* club.

Hab. On dead wood; autumn and winter, frequent.

5. **H. leiocar'pa** Lister.—Sporangia scattered, obovoid, pale or ochraceous grey, on grey stalks. Capillitium a network of grey threads, marked with 3 to 5 bands forming dextral spirals (not sinistral, as in other species of *Hemitrichia* and in *Trichia*). Spores pale grey in mass, smooth, 6 to 8 μ diam. Name Gr. *leios* smooth, *carpos* fruit, from the smooth sporangium-wall.

Hab. On dead wood; rare.

6. **H. abieti'na** Lister.—Plasmodium rose-red. Sporangia crowded or scattered, shining ochraceous, turbinate, on short

ochraceous stalks. Capillitium a tangle of flaccid ochraceous threads, marked with 1 to 3 narrow bands arranged in a lax often irregular spiral, with few rounded free ends. Spores yellow, minutely warted, 9 to 12 μ diam. Name from L. *abies* a fir-tree, from the sporangia often occurring on fir-wood.

Hab. On dead wood; autumn and winter, not common.

7. **H. min'or** G. Lister. — Plasmodium watery cinnamon. Sporangia scattered, subglobose, sessile or shortly stalked, or forming curved plasmodiocarps, buff, 0·2 to 0·4 mm. diam. Stalk black. Capillitium a loose network of flaccid yellow threads marked with 3 to 5 faint lax spiral bands, smooth or studded with scattered spines. Spores yellow-buff, closely warted, 9 to 10 μ diam. Name L. less.

Var. **pardi'na** Minakata. — Sporangia marked with prominent black warts, pale buff elsewhere; capillitium spirals usually dextral. Name L. like a leopard.

Hab. On hedge clippings, and on dead or living bark amongst liverworts; autumn and winter, uncommon. The single specimen from Dorset, on which the claim for *Trichia erecta* Rex to be a British species has depended, proves on further examination to be *H. minor* var. *pardina*.

8. **H. Karsten'ii** Lister.—Sporangia curved or branched brown or ochraceous plasmodiocarps, or globose. Except that the capillitium-threads are combined into a network, this species agrees with *Trichia contorta*. Named after P. A. Karsten, a Finnish botanist.

Hab. On dead wood; autumn and winter, frequent.

9. **H. Ser'pula** Rost.—Plasmodium yellow. Plasmodiocarps, 0·5 mm. broad, winding or forming a net, golden yellow. Capillitium-threads yellow, with 3 to 5 well-marked spiral bands, strongly spinose. Spores yellow, 10 to 12 μ diam., reticulate with narrow bands, giving a border 1 μ diam. Name; a genus of marine worms with curved shells.

Hab. On dead wood; rare.

10. **H. chrysos'pora** Lister.—Sporangia subglobose, 0·7 mm. diam., sessile, crowded, bright yellow. Capillitium-threads yellow, with 4 or 5 close spiral bands. Spores yellow, 14 to 18 μ diam., neatly reticulated with deep narrow bands, giving a border 1 or 2 μ wide. Name Gr. *chrusos* gold, *spora* spore.

Hab. On fallen larch; winter, rare; perhaps only a sessile form of *T. verrucosa*, with elaters combined into a net.

GENUS 38. **CORNU'VIA** Rostafinski.—Sporangia sessile; capillitium-threads with ring-shaped thickenings. Named after Maxime Cornu (1843–1901), a French botanist.

1. **C. Ser'pula** Rost.— Plasmodium cream-white. Sporangia scattered, subglobose, 0·3 mm. diam., or forming small curved, branched or net-like plasmodiocarps, shining yellow. Capillitium a network of yellow threads marked with close-set ring-like thickenings. Spores yellow, rather closely reticulated, 10 to 12 μ diam. Named from a genus of marine worms with curved shells.

Hab. On spent tan; spring.

Fig. 46.—CORNUVIA SERPULA Rost.
a. Plasmodiocarp. Magnified 7 times.
b, Capillitium. Magnified 230 times.
c. Spore. Magnified 400 times.

ORDER II.—ARCYRIACEÆ.

GENUS 39. **ARCYR'IA** Wiggers.—Sporangia stalked; sporangium-wall persistent below as a membranous cup; stalks filled with spores or spore-like cells; capillitium forming an elastic network. Name from Gr. *arkus* net.

Fig. 47.
ARCYRIA DENUDATA Sheldon.
a. Group of sporangia. Twice natural size.
b. Capillitium. Magnified 250 times.
c. Spore. Magnified 560 times.

1. **A. ferrugin'ea** Sauter.— Plasmodium rose or cream-coloured. Sporangia turbinate, about 0·7 mm. broad, crowded, orange-red, rarely ochraceous; the cup reticulated with smooth round-meshed thickenings. Capillitium-threads free from the cup, subtriangular in section, thickened with transverse bands and spines on one side, with broken reticulation on the others. Spores ochraceous, minutely warted, 9 to 11 μ diam. Name L. rust-coloured.

Var. **Heterotric'hia** Torrend.—An irregular form with many free ends to the capillitium. Name Gr. *heteros* different, *thrix* thread.

Hab. On dead wood; frequent, especially in autumn.

2. **A. cine'rea** Pers.—Plasmodium white. Sporangia ovoid, often united in small clusters, pale grey or yellowish, variable in size. Capillitium attached to the cup; threads minutely and closely warted, or spinulose, the lower threads usually smooth. Spores nearly smooth, 6 to 7 μ diam. Name L. ashen.

Var. **car'nea** Lister.— Sporangia flesh-coloured; capillitium marked with a loose spiral of flat-toped spinules. Name L. flesh-coloured.

Hab. On dead wood and leaves; common, from summer to winter.

3. **A. pomifor'mis** Rost.— Sporangia scattered, subglobose, yellow. Capillitium marked with spines arranged in an open spiral. Spores as in *A. cinerea*, to which this species is closely allied. Name L. *pomum* apple, *forma* shape.

Hab. On dead wood; frequent, summer to winter.

4. **A. denuda'ta** Sheldon.—Plasmodium white. Sporangia ellipsoid or conico-cylindrical, about 0·9 mm. broad, crimson, gregarious. Stalks 0·5 to 1 mm. long. Capillitium attached to the cup; threads without free ends, thickened with half-rings, cogs or spines arranged in a loose spiral. Spores nearly smooth, 7 μ diam. Name L. naked.

Hab. On rotten wood. Common, throughout the year.

5. **A. incarna'ta** Pers. — Plasmodium white. Sporangia shortly cylindrical, 0·6 mm. broad, flesh-colour, crowded. Stalks short, pale red. Capillitium free from the cup; the threads often forming rings, with few o: many free spinose clavate ends; the thickenings as in *A. denudata*, but usually more spinulose. Spores nearly smooth, 7 μ diam. Name Mod. L. clothed in flesh, from the colour of the sporangia.

Var. **ful'gens** Lister.—Sporangia crimson; stalks well developed. Name L. bright.

Hab. On dead wood and sticks; common, throughout the year.

6. **A. insig'nis** Kalchbr. & Cooke.—Plasmodium watery white. Sporangia clustered in scattered groups, ovoid or cylindrical, pale rose-coloured, on red stalks. Capillitium a network of pale delicate threads, 2 to 5 μ diam., with a few free ends, marked with a lax spiral of thickenings in the form of half-rings and short spines. Spores nearly smooth, 6 to 8 μ diam. Name L. remarkable.

Hab. On dead wood; rare.

7. **A. stipa'ta** Lister.—Sporangia shortly cylindrical, 0·6 to 0·9 mm. broad, copper-colour. Capillitium an elastic network resembling that of *A. denudata* except in the threads being marked with 2 or 3 spiral bands in addition to the cogs and half-rings. Spores nearly smooth, 7 μ diam. Name L. crowded.

Hab. On dead wood; not common.

8. **A. nu'tans** Grev.—Plasmodium white. Sporangia cylindrical, about 0·4 mm. broad, ochraceous, crowded. Capillitium free from the cup, expanding into a drooping column many times the length of the sporangium; threads beset with sharp spines and half-rings, arranged in a loose spiral. Spores nearly smooth, 7 μ diam. Name L. nodding.

Hab. On rotten wood; common, summer and autumn.

9. **A. Œrsted'tii** Rost.—Differs from *A. nutans* in being dull crimson in colour, and in the slender threads being more evenly spinulose. Named after Prof. A. Oerstedt (1816 to 1874), a Danish botanist.

Hab. On fir-wood; summer, autumn.

GENUS 40. **LACHNOB'OLUS** Fries.—Sporangia sessile, clustered. Capillitium a loose network of threads attached to many parts

of the single-layered persistent sporangium-wall. Name Gr. *lakhne* wool, *bolos* lump.

1. **L. conges'tus** Lister.—Sporangia subglobose, shining ochraceous or coppery; sporangium-wall membranous, firm, papillose. Capillitium of freely branching ochraceous-yellow threads, closely and equally marked with prominent warts. Spores pale yellow, almost smooth, 6 to 8 μ diam. Name L. heaped.

Hab. On dead wood; summer, autumn, not common.

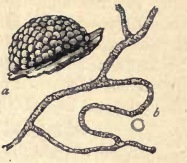

Fig. 48.

LACHNOBOLUS CONGESTUS Lister.

a. Cluster of sporangia. Twice natural size.
b. Capillitium and spore. Magnified 300 times.

GENUS 41. **PERICHÆ'NA** Fries.—Sporangium-wall usually of two layers, the outer thickened with dark granules. Capillitium of slender branching threads, minutely warted or spinose. Name Gr. gaping, from the sporangium-walls often splitting all round.

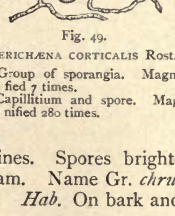

Fig. 49.

PERICHÆNA CORTICALIS Rost.

a. Group of sporangia. Magnified 7 times.
b. Capillitium and spore. Magnified 280 times.

1. **P. chrysosper'ma** Lister.—Plasmodium pale brown. Sporangia curved or ring-shaped brown plasmodiocarps, sometimes subglobose, rarely stalked; sporangium-wall subcartilaginous, with external granular deposits; stalk dark brown, or black. Capillitium profuse, bright yellow, of sparingly branched threads usually marked with numerous straight or curved spines. Spores bright yellow in mass, nearly smooth, 9 to 10 μ diam. Name Gr. *chrusos* gold, *sperma* seed.

Hab. On bark and wood; autumn and winter; not common.

2. **P. depres'sa** Libert. — Sporangia flat, polygonal, crowded, brown, dehiscing by a well-defined lid; outer layer of the sporangium-wall cartilaginous, inner membranous. Capillitium a web of branching slender yellow threads, 2 μ diam., minutely warted and marked with close-set regular constrictions. Spores yellow, nearly smooth, about 10 μ diam. Name L. flattened.

Hab. On bark and dead wood; frequent in autumn and winter.

3. **P. cortica'lis** Rost.—Plasmodium watery white. Sporangia subglobose or hemispherical, crowded, rarely forming scattered plasmodiocarps, purple- or nut-brown, buff or grey, dehiscing with a lid. Capillitium usually scanty, of slender flaccid threads; sometimes absent. Spores yellow, 11 to 14 μ diam. Name from L. *cortex* bark.

Var. **affi'nis** Lister.—Sporangia red-brown, dehiscing irregularly; capillitium more abundant, less flaccid than in the typical form. Spores 10 to 12 μ diam. Name L. allied.

Var. **liceoi'des** Lister.—Sporangia minute, 0·1 to 0·5 mm. diam., shining yellow or nut-brown, with translucent walls. Capillitium usually scanty or none, sometimes forming a close network. Spores 10 to 15 μ diam. Name from the genus *Licea*.

Hab. On dead bark and wood; frequent, especially in autumn and winter; var. *liceoides* on hedge-clippings and rabbit pellets.

4. **P. vermicula'ris** Rost.—Plasmodium watery or rose-colour. Sporangia curved or netlike plasmodiocarps, sometimes globose, 0·5 mm. diam., scattered, dull yellow or umber; outer layer of sporangium-wall more or less charged with dark angular granules, and closely combined with the membranous minutely papillose inner layer. Capillitium a profuse web of yellow threads, rough with minute warts and with irregular constrictions. Spores yellow, nearly smooth, 10 to 13 μ diam. Name from L. *vermiculus* a little worm.

Hab. On dead leaves, herbaceous stems and wood; not uncommon in autumn and winter.

ORDER III.—MARGARITACEÆ.

GENUS 42. **MARGARI'TA** Lister.—Sporangia globose, with a translucent wall. Capillitium a profuse coil of slender, hair-like, scarcely branching threads. Name L. pearl.

Fig. 50.
MARGARITA METALLICA Lister.
a. Two sporangia. Magnified 6 times.
b. Part of a long capillitium-thread, and a spore. Magnified 250 times.

1. **M. metal'lica** Lister.—Plasmodium watery or rosy. Sporangia solitary or clustered, about 0·7 mm. diam., pearl-grey or copper colour, iridescent. Capillitium of very long grey threads about 1 μ broad. Spores pinkish grey, nearly smooth, 10 to 11 μ diam. Name L. metallic.

Hab. On dead leaves, twigs and rotten wood; autumn and winter.

GENUS 43. **DIANE'MA** Rex.—Sporangia sessile; sporangium-wall membranous or cartilaginous. Capillitium consisting of nearly straight threads, slender at both ends, attached above and below to the sporangium-wall. Name Gr. something spun, from the character of the capillitium.

1. **D. Har'veyi** Rex.—Plasmodium white. Sporangia pulvinate or curved plasmodiocarps, 1 mm. diam., dull red or bronze. Capillitium-threads erect, simple except at the ends, where they are attached by several short branches to the sporangium-wall, rarely branched and anastomosing throughout. Spores pale yellowish or pinkish grey; ochraceous or brick-red in mass, nearly smooth, 8 to 10 μ diam. Named after F. L. Harvey, who first collected the species at Orono, Maine, U.S.A., about 1891.

Hab. On dead wood; autumn and winter, uncommon.

2. **D. depres'sum** Lister.—Plasmodium white or rosy. Sporangia pulvinate, depressed, 2 to 5 mm. wide, at first shining violet, maturing to grey-brown. Capillitium-threads slender, rigid, forking and uniting above and below, where they are attached to the sporangium-wall by suddenly acuminate ends. Spores yellowish grey, delicately reticulate, 6 to 8 μ diam. Name L. flattened.

Hab. On dead wood; autumn and winter.

Fig. 51.
DIANEMA DEPRESSUM Lister.
a. Plasmodiocarp. Magnified twice.
b. Capillitium attached above and below to the walls of the sporangium. Magnified 50 times.
c. Spore. Magnified 560 times.

3. **D. cortica'tum** Lister.—Plasmodium pink. Sporangia simple or net-like plasmodiocarps, 3 to 12 mm. long, glossy brown. Sporangium-wall of two layers, the outer cartilaginous, olivaceous, the inner hyaline. Capillitium of simple or acutely branching, slender, brown or pale threads, 0·5 to 1·5 μ diam., smooth or with beadlike thickenings, and sometimes with a prominent spiral band, or rarely with three spirals for a short distance. Spores nearly colourless, brownish pink in mass, subellipsoid, 11 × 9 μ diam., minutely warted on one side, adhering in clusters of 4 to 6. Name L. having a bark, from the stout sporangium-wall.

Hab. On dead coniferous wood; summer to winter, not common.

GENUS 44. **PROTOTRIC'HIA** Rostafinski.—Sporangia globose. Capillitium arising from the base of the sporangium as stout solid threads marked with spiral thickenings, branched, and dividing into a pencil of slender branchlets attached at the tips to the upper parts of the sporangium-wall. Named from Gr. *protos* first, and the genus *Trichia*.

Fig. 52.
PROTOTRICHIA METALLICA Mass.
a. Group of sporangia. Magnified 4 times.
b. Capillitium attached above to a fragment of the sporangium-wall, and a spore. Magnified 280 times.

1. **P. metal'lica** Mass.—Plasmodium white. Sporangia about 0·7 mm. diam., sessile, crowded or scattered, rarely stalked, pinkish brown or copper-colour, shining. Capillitium pale olive or brown. Spores pale brownish pink in mass, nearly smooth, 10 to 11 μ diam. Name L. metallic.

Hab. On dead sticks; not uncommon, especially in winter.

GLOSSARY

Æthalium: A compound fructification formed by the union of many sporangia; the walls of the inner sporangia are more or less imperfectly developed.

Amœbula: A swarm-cell which creeps about by the aid of pseudopodia.

Anastomosing: The uniting of one branch with another.

Areolated: Divided into small spaces.

Capillitium: A system of simple or branched, solid or tubular threads, developed within the sporangium, and aiding in the dispersion of spores.

Cartilaginous: A term applied to a stout, uniformly thickened membrane.

Columella: A structure arising from the base of a sporangium and giving attachment to the capillitium; it may be either convex, conical or cylindrical; in stalked sporangia it is continuous with the apex of the stalk.

Cortex: An outer covering investing an æthalium.

Cyst: A Protozoan cell, in its resting stage, secretes a firm envelope or *cyst* round its body.

Elaters: Free tubular capillitium threads marked with spiral thickenings, characteristic of the genera *Trichia* and *Oligonema*.

Flagellula: A swarm-cell provided with a flagellum.

Flagellum: The whip-like organ of motion of a swarm-cell.

Fusiform: Spindle-shaped.

Hyaline: Glassy clear, colourless.

Hypothallus: A membranous base from which the sporangia or their stalks arise.

Lime-knots: Bladder-like expansions in capillitium threads, containing granules of calcium-carbonate.

Microcyst: The resting condition of a swarm-cell when it becomes spherical and is enclosed by a firm wall.

Nodes: In the genus *Cribraria* the sporangium-wall persists as a net of slender threads with expanded *nodes* or points of junction.

Plasmodic granules: Minute, strongly refracting, coloured granules embedded in the sporangium-wall in the genera *Lindbladia*, *Cribraria* and *Dictydium*.

Plasmodiocarp: A sessile sporangium on a long or expanded base.

Plasmodium: A mass of naked protoplasm originating in the union of a pair of swarm-cells, whose nuclei also unite; growing by feeding and by fusion with other plasmodia, and exhibiting a rhythmic circulation.

Pseudo-columella: A mass of lime-knots confluent in the centre of a sporangium and remaining free from the stalk.

Pseudopodium: An organ of temporary nature extruded from the protoplasm when required, and retracted when no longer needed.

Pulvinate: Cushion-shaped.

Pyriform: Pear-shaped.

Sclerotium: The resting-stage of the plasmodium, consisting of closely packed cysts, each containing ten to twenty nuclei.

Sporangium: A receptacle containing spores.

Sporophore: A structure bearing spores on the surface.

Swarm-cell: An active germ that emerges from a spore.

Turbinate: Top-shaped.

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